THE
# ELECTRICAL REVIEW.

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## "ELECTRICAL REVIEW."

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## WESTINGHOUSE ON CONSULTING ENGINEERS.

A FEW months ago some correspondence dealing with the consulting engineer question appeared in *Engineering*, the subject having been introduced by Mr. George Westinghouse in his last address as chairman of the British Westinghouse Electric and Manufacturing Co.

Mr. Westinghouse's contention is that, in many of the larger electrical schemes at present contemplated, especially in the electrification of our railways, it will be more economical and advantageous to purchasers to place their entire contract in the hands of one firm of contractors, to act on their advice, and to take their standard designs, than to employ a consulting engineer to draw up the scheme, divide the contracts into sections and distribute them among several contractors.

This method of procedure, unusual, at all events, so far as this country is concerned, was challenged in the columns of *Engineering* by a "British Engineer," to whom Mr. George Westinghouse subsequently replied, his reply calling forth a further rejoinder.

Without going into the various details contained in these letters, we must admit that great changes are taking place in our midst—changes which are likely to very materially alter the procedure of business in the future.

Many of the schemes at present contemplated are of considerable magnitude, and likely to increase in size as time goes on, in addition to which they are, to a large extent, being introduced and promoted by private interests, a state of affairs to which we have not been accustomed in the past. To keep pace with this changing order of things, contracting and manufacturing firms have come into existence, which, like the firm mentioned by Mr. Westinghouse, namely, Westinghouse, Church, Kerr & Co., are organised for carrying out complete schemes in all their details, and for dealing with them without outside assistance.

This means, of course, a staff of engineers who are specialists in the various branches of the business involved, as manifestly it would be difficult for a single individual to obtain more than a superficial knowledge of them all.

There can be no doubt, therefore, that factors such as these may interfere to a large extent with the position which our consulting engineers have hitherto held as intermediaries between the purchaser and manufacturer.

Schemes such as the adoption of electrical working for portions of our railway systems, are sufficiently important to warrant the creation of a special staff of the railway company, with a capable engineer at the head, for dealing with the whole matter. Many railways already retain the services of a consulting engineer for their general work; doubtless a second engineer would usually be requisitioned as electrical expert, to report on the various schemes submitted by the respective tenderers.

Contracting firms, such as the one referred to by Mr. Westinghouse, are undoubtedly in a better position, with a large staff of engineers specialised in the various branches, for preparing and carrying out large schemes, than a single engineer, and from this point of view their advice must of necessity be valuable.

The objection to this, raised by "British Engineer," can, however, not be overlooked; any contracting firm attached to a firm of manufacturers is of necessity limited in drawing up its scheme to the types of apparatus manufactured by its ally, and it is quite possible that some of this apparatus may not be perfectly suited for the special requirements of the case, and could be purchased to better advantage in other quarters.

It would seem questionable, too, whether the purchasing engineers would be able to sufficiently familiarise themselves with the different systems and types on the market to enable them to come to a correct conclusion in dealing with these matters. On the other hand, it must not be overlooked that any firm of first-class contractors would, presumably for its own reputation, adopt those systems and that apparatus in all its details, which were thoroughly up to date and suitable for the special work involved.

Passing from large schemes to smaller ones, the question has frequently been raised whether private works adopting electrical power, as so many of them are doing at present, are studying their own interests to the best advantage in calling in a consulting engineer to draw up the scheme for them.

We believe Mr. Westinghouse did not refer to this particular branch of the business, but at the same time his conclusions, so far as railway work are concerned, would seem to apply here also. Many works have employed consulting engineers to draw up their schemes, whereas in some cases others have asked a limited number of contractors to prepare their own schemes and recommendations, and have adopted the one which seemed to them the most suitable.

There can be little doubt that in the majority of cases the latter course of procedure is the one most advantageous to the purchaser. The difficulty, so far as this class of business is concerned, has always been that with the exception of a very limited number of consulting engineers, no special study has been made of this branch of the business, and the experience has been gained chiefly by contractors. By depriving them, therefore, of the opportunity of making their own suggestions, and of drawing up their own schemes, valuable experience is lost to the purchaser.

Perhaps the best plan for this class of business is to invite a limited number of contractors to prepare their own tenders, and then to get an impartial consulting engineer to report on the relative values of the respective quotations, a result at which the average works manager has often some difficulty in arriving.

The custom of employing consulting engineers was brought into existence in this country through our system of municipal trading, and has without doubt been justified in the past. The remarks of Mr. Westinghouse, however, set one thinking as to whether the trend of business in the future will not be in other directions, and whether so large a proportion of our numbers will continue to devote their energies in this consulting capacity.

The tendency would seem to be to curtail municipal expenditure and to encourage private enterprise: in addition to which much of our municipal work is coming to a natural end, the extensions required from time to time being largely carried out by those in charge of the stations. The fact can, therefore, not be overlooked that the immediate future would not seem to require so large a body of consulting engineers as our system of municipal trading has in the past necessitated.

That there will be, and already is, abundant scope in other directions few will deny, and it would seem to be only a question of time, and that most probably a short one, when many will find it to their advantage to gradually drift out of consulting work, and for our industry in this respect to assume the conditions common in America and on the Continent, where the majority of the engineering schemes are prepared by the contractors and not by consulting engineers. We are not prepared to say that such a course would prove to be an unmixed blessing to the old country, for American and Continental methods are not always of the kind to which Englishmen have been accustomed, nor is their engineering free from the suspicion of unsoundness.

Even with consulting engineers behind them, American contractors have not gained unqualified approval nor given universal satisfaction amongst us. What will be the result if the contractor is allowed to work his own sweet will upon us?

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The I.E.E. in Italy.

The periodical excursions of members of the Institution to the Continent have become so regular as to excite but little interest; but the remarkable enthusiasm with which they have been received on this occasion by the Italians is worthy of more than passing mention.

The Italians, not without good reason, regard the British as firm friends and ancient allies, while they, alone among the nations of Europe, appreciate the sacrifices which we have made in the cause of liberty and progress, and cherish a deep-rooted feeling of gratitude towards us for the practical sympathy which we have always manifested for their political aspirations. Hence, a Briton is in Italy certain of a hearty welcome, and he knows that it is *sincere*. In this connection we may be allowed to quote the words inscribed upon the programme of a serenade performed in honour of the English guests at Como:—

"Gentlemen—For your visit to the tomb of our immortal citizen, we are most grateful. Your nation has always had sympathy for the cause of Italian liberty.

"We remember, and we are thankful to great England, Mistress of Commerce and Civilisation.

"Como salutes you with all its heart."

The words which we have quoted are typical of the burning words and heartfelt sentiments which were uttered on various occasions during the Italian tour; and no better proof of their sincerity could be found than in the wholly friendly attitude of the Italian nation towards us during the Boer war, when all Europe—save Italy—heaped abuse upon us. We rejoice, therefore, that the visit of the British engineers to Northern Italy, to pay homage at the tomb of the great Volta, and to admire the splendid achievements of Italian civilisation, should thus have afforded an opportunity for cementing the good relations which have so long subsisted between Italy and Great Britain. *Viva l'Italia!*

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Wanton Waste.

It is well known that the waste of fuel in the coal fields is enormous. From our own experience, we should say that it is in the Staffordshire area that there is least regard paid to real economy in any shape, and in which there is least known—or seen, at any rate—of modern labour-saving appliances.

This lamentable state of things arises, possibly, from the fact that all but a very few of the collieries are small, and would seem utterly insignificant when compared with collieries in the North or in South Wales capable of raising 3,000 to 4,000 tons per diem. Nevertheless, although small, it is usual to find more than one owned by one firm, and it would be natural to suppose that in such cases the advantages of economical methods would be evident.

It is true that when the pit is some distance from the loading "wharf" there is a cable-way to transport the coal, although it would be quite on a par with the rest of the work if this were done by hand, for the tipping is done by hand, and so are the sorting, or screening, and loading. The largest coal is picked out by hand, the smaller varieties being sorted by men with pronged forks, the remainder being thrown generally, but not always, through a screen. It follows that there are, perhaps, only three qualities of coal offered for sale, and washing is practically unknown.

About the only engine in a colliery of this description is the pumping and winding engine; unless there is a separate pump shaft, and the water is brought to the surface in tubs!

These are a few instances only of the old-fashioned methods employed, and they show, of course, wanton waste, but are not intended to supply the meat for picking off the present bone. We are concerned just now with the coal which is small enough to pass through the last screen—sometimes the only real one. This coal is practically dust, hardly any of it being as large as what one used to term swan-shot in the catapulting days, but there is just as much carbon as there is in the larger coal, and probably less clinker-making residue in it.

What becomes of this "fine slack"?—it is not considered worthy the name of coal. As much as can be used under the colliery boilers is burned there, greatly to the firemen's disgust, if one asks, for there is nothing but a small, and often leaky, stack to produce the necessary draught, and firing under these conditions is hard work. When the firemen find that they have to burn the stuff there seems to be no difficulty in keeping a full head of steam, and it occurs to one that this kind of job must add to the too small stock of good firemen in the world, for nothing but systematic working and unremitting attention will produce the requisite results. As a consequence the men keep good thick fires, and use the shovel frequently, generally placing the coal on the dead plate.

If the colliery is an adjunct to an iron-works, or a brick-works, it may be that most of the finest slack made will be consumed, but even then it is burned under shocking economic conditions. The sole idea of the management is to get rid of the stuff by one means or another, and they do it with more or less success, entirely ignoring the fact that by the time they have paid for the extra labour in handling and firing, and for the extra boilers needed to burn the dust with poor natural draught, it might have paid them to have tipped it with the dirt. They know that there is no market for such low grade coal, and it does not occur to them that there ought to be, or that it rests very much with them, as with the vendors of any kind of goods, to make such market. But the thing that is so deplorable, is the actual tipping of this fine coal as if it were rubbish. Only the other day we saw a colliery road being made with it, ton after ton being thrown down to level a depression created by subsidence; and the whole of the surrounding country is full of such evidence of waste.

Is there any remedy, and is not the matter a national one? We have no intention of entering into the latter question, but any engineer can answer the first.

Forced draught furnaces suggest themselves at once, but the objection offered to these by the managers would be that they would save fuel, and they have trouble enough to get rid of it as it is. They can afford to sell this fine coal at 6d. to 1s. per ton at the pit, and they ought to make a market for it by holding its cheapness out to neighbouring manufacturers as an inducement to instal means of burning it economically. The reply to that would be, that they would be cutting their own throats by selling a cheap grade fuel in place of a better grade; and the kind of man who advances that kind of argument will never be convinced that better results cannot be obtained with waste of any description, than with the least waste possible.

Perhaps the makers of forced draught appliances might bestir themselves to greater proselytizing efforts.

Another possible solution comes in the shape of briquettes. We do not know into what figure a briquette-making plant would run. Moreover, it is probable that the daily output of lowest grade coal from any one of the small collieries under mention would not be sufficient to supply the smallest practicable plant; but collieries are never a great distance apart, and one large central briquette plant might serve several collieries with a sufficient collective output.

Of course, as railway rates are at present—and ever will be, as we fear—there is no doubt that it would not pay to send low grade fuel any distance, but the idea appeals to the outsider that it might pay to carry briquettes made of the same grade for considerable distances.

There must be some solution of the problem, and one would suggest to engineers in colliery districts, if, indeed, it is necessary, that they should consider the possibilities of a cheaper fuel.

## WIRELESS TELEGRAPHY IN THE UNITED STATES.

By E. GUARINI.

The first experiments in wireless telegraphy, and the first patents taken out in connection with this branch of telegraphy in the United States, date from long ago. Without going back to the attempts of Morse in 1842, we must begin as far back as 1891. In that year, in his patent No. 465,971, dated December 29th, taken out for his system of transmission of electric signals, Thomas Alva Edison expressed as follows his first claim:—"A method of transmitting signals between stations separated from one another, consisting of an elevated condensing surface at each station, of a transmitter connected with one of these condensing surfaces in order to modify its electric tension according to the signal to be transmitted, and thus varying in a corresponding manner the tension of the other condensing surface, and of a receiver connected with the other condensing surface in substance as described."

Few people have a clear or adequate idea of the importance of this patent of Edison's in the history of wireless telegraphy. The greater number of the component parts of the present systems of wireless telegraphy are found in it; the antennæ, the coil, the connections to earth. The receiver of the future will probably be Edison's, *i.e.*, a receiver in which the energy of the wave works directly the apparatus that operates the signals.

A complete Edison station was constituted as follows (fig. 1):—A source of current, either variable in itself or

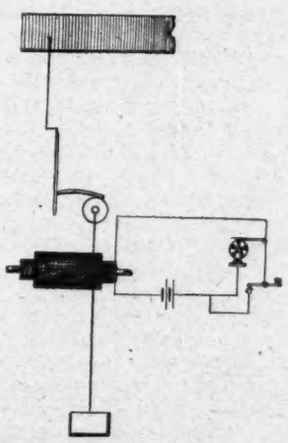


Fig. 1.

rendered so by an interrupter, fed the primary of an induction coil, the secondary of which was, at one end, connected to earth; and at the other through a telephone by a vertical wire to a capacity, *e.g.*, a plate, placed at a certain height.

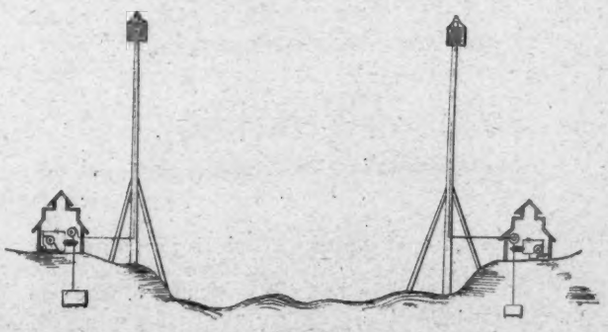


Fig. 2.

Communication was established between two stations by providing each of them with a similar apparatus (fig. 2). On working the coil the high pressure current of the secondary charged the antenna and the capacity. An induced current

was produced in the capacity and in the antenna of the other station. This current proceeded towards earth through the winding of the telephone. A sound was heard in the telephone, and its duration was in proportion to that of the primary current.

The writer may remark in passing that it was with the aid of the Edison transmitter, and by the substitution of a coherer for the telephone in the receiver, that he was able to effect the overland experiments over a distance of 44 km. between Brussels, Mechlin and Antwerp (Electrical Review, May 24th, June 7th and 28th, and July 12th, 1901), and by means of which he is able to dispense with the Hertzian waves, which are generally thought indispensable, in realising long-distance wireless telegraphy. This is in no way surprising: the current which an antenna on open circuit can send out is the product of the frequency and the capacity. Thus two methods of radiating great energy present themselves:—(1) To use a high frequency (Hertzian waves) and antennæ of small capacity. This is the method employed by Marconi, Braun, Slaby, &c. (2) To employ a current of low frequency and antennæ of great capacity. This is the method used by Edison and by the writer.

In concluding these remarks upon the Edison system, we will here quote a passage from his patent, which will remain one of the most noteworthy pages in the still early history of wireless telegraphy:—"I have discovered," says Edison, "that if we get an elevation sufficient to clear the curvature of the earth, and to reduce to a minimum the absorption of the earth, electric telegraphy, or the interchange of signals between far distant points, can be worked by induction without the use of wires connecting these points. This discovery is specially applicable to telegraphy across masses of water, so as to avoid the use of submarine cables, or to communication between vessels at sea or between vessels at sea and stations on land; but it is also applicable to electric communication between distant points on land, although on land (except in the case of open prairies) there is always the necessity of increasing the elevation in order to reduce to a minimum the absorbing effect of houses, trees, and elevations of the ground itself. At sea, with an elevation of 100 ft., I can send electric communications to a great distance, and as this height can be attained by using the masts of ships, signals can be transmitted and received between vessels separated by a considerable distance, and if these signals are repeated to other vessels, communication can be established for any distance, even across the largest seas and oceans. Collisions during fogs can be prevented by this system of signals, which might also be used to warn a vessel approaching a dangerous coast during foggy weather. For communications between points on land, poles of great height may be used, or captive balloons."

Edison, as we see, proposed captive balloons, antennæ, repeaters—in fact, all that is now being used, and all that is at present likely to be used, at any rate on land.

After Edison's apparatus, those designed by Mr. Phelps, with a view to effecting communication between trains in

Fig. 3.

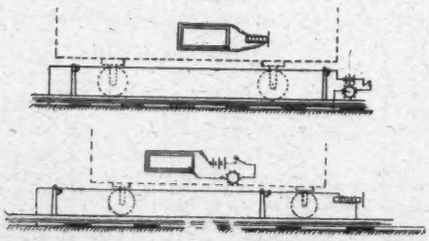


Fig. 4.

motion, are worthy of attention, though they are not strictly wireless (figs. 3 and 4). The system comprises:—

1. Between the rails a line, the extremities of which are connected to earth.

2. A rectangular coil placed vertically on the train, as near as possible to the line.

The transmitting system comprises a variable source of current, *e.g.*, a toothed wheel interrupting the current of a battery; the receiving system, a simple telephone. Fig. 3 shows the arrangement required for sending signals to the train; fig. 4, that which is required at a station for the reception of signals sent by a train.

In order to allow of communications in both directions, each station consists of a transmitter and a receiver, placed in circuit in succession.

An application having the same object was designed by Gilliland with a modification of the Edison system. In the Edison-Gilliland system, as applied to railways, a line goes along the track; the metal roofing of the carriage constitutes the capacity of the Edison system; the wheels form the connection to earth. In the line, as on the train, the Morse key serves to switch on the antenna.

Another most interesting patent was taken out in 1897; this time by Mr. Nicola Tesla, who has become famous through his Martian communications and his towers, which in 1899 were constructed for wireless telegraphy. He took out the patent in question for "improvements in the system for the transmission of electrical energy, and in the apparatus used for this transmission." The title is most modest, but when we penetrate into the details we soon perceive that we have before us a Pindaric flight of the fertile imagination of the child of Montenegro.

In principle the Tesla method consists in establishing a circuit in which the rarefied air of the upper strata of the atmosphere serves as the outgoing and the earth as the return conductor.

As in the Edison system, the transmitter consists of an induction coil, but an induction coil of special construction, the high pressure circuit of which is connected at one end to earth and at the other to a disc supported by a balloon in the rarefied air of the upper strata of the atmosphere. The arrangements made for the reception are similar to those used for the transmission. The fine wire winding of the transformer is connected at one extremity to earth and at the other to the aerial disc. The thick wire circuit of the transformer comprises lamps, motors, &c., which it is designed to feed.

Without doubt electricity owes some important discoveries to Tesla. But in this case we fear that his so-called invention, or discovery, will remain a dead letter and never be carried out in a practical way.

Tesla compares his system to a Geissler tube fed by the secondary of an induction coil, and draws from this comparison conclusions too long to reproduce here. But is the comparison justified? Can the Tesla system really be compared to the Geissler tube? That is the question. Admitting that a sufficiently high pressure can be produced to overcome the resistance of the earth and of the rarefied air, why should the current go towards the Tesla receiver, and not in all directions? Would not the conduction of the air and the earth constitute a serious difficulty? We can limit the area of *radiation*, but how can we limit the *conduction* of the earth and the atmosphere to certain sectors? Moreover, if the whole of the surrounding earth and atmosphere be involved, has Mr. Tesla thought what a small quantity of energy would arrive at his receiver, if, indeed, any arrived?

Mr. Tesla, however, has not given up his idea, and does not own himself beaten. Moreover, the New York *Electrical World and Engineer* recently published an engraving and a short description of a tower constructed by Tesla at Wardencliff with a view to experiments in wireless telegraphy, and in the transmission of energy without conductors to Europe and Australia, where corresponding stations are to be established. *Qui vivra verra!* In the meantime, let us glance at some other systems.

*(To be continued.)*

## SIGNALLING ON SINGLE LINE TRAMWAYS.

By LIONEL E. HARVEY, A.M.I.E.E.

Signalling on single line tramways with loops may be divided into two classes—hand-operated and automatic.

With regard to hand-operated signals, the method usually adopted is a bank of lamps at the end of a section, lighted from a switch at the beginning of the section.

Two small wires are run on insulators the whole length of the single track section, or two insulated wires or a twin-wire

are laid underground. The method of operation is as follows: The conductor of an "up" car entering a single-line section at A puts on the switch, and lights the lamps at the far end, B. The conductor of the next "down" car puts his switch on at B as he enters the section, and when he reaches the end, A, he turns off the switch that the conductor of the "up" car had put on, and so on.

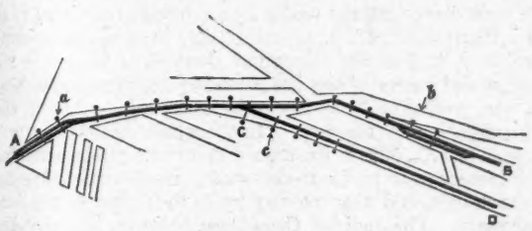
This method is, of course, very primitive, and is only applicable where there is a small service of cars.

It has the disadvantage that if the signalling wires are run, as usual, overhead, they have to have guard wires over them at places where the guard wire is fixed over the trolley wire.

Where there is anything like a frequent service of cars over a single-line section, it is quite necessary to have some sort of automatic system of signalling.

Now, these can be divided into two classes—those using the main trolley wire current to actuate them, and requiring no additional signal wires; and those whose mechanism is operated by a shunt current, requiring two signal wires to be run the whole length of the section to be protected.

Taking the former case, section insulators have to be put up at each end of the single-line section. A car entering a section at A passes a section insulator, and then gets all its current from the feeder connected at the far end B through




Automatic Signalling.

the signalling apparatus, the latter being operated by the current that the car takes, and the signal is locked at "danger," so that if the car comes to rest on the section, the signal will not be dropped. When the car reaches the far end B, it makes an auxiliary contact, which drops the signal; a similar arrangement being made for the down car and its wire.

This system has three disadvantages:—(1) There must be a feeder wire the whole length of the single-track section, so that in the very common case of the last mile of a route being fed by the overhead trolley wires only, special feeder wires must be laid on purpose for the signals. (2) Section insulators must of necessity be used, and with these the difficulty arises that they should be erected on a straight, or very nearly straight, trolley line, and therefore where the approaches to the section of track to be dealt with are sharp curves the system is difficult of application. On this point it may be observed that with side-arm construction, where the poles are on the convex side of a curve, the trolley wire can be pulled in straight at the particular pole where the section insulator is by means of a pull-off on each side of the arm; but where the poles are on the concave side of a curve this is impossible, unless an extra pole be planted on the opposite side of the road to which to attach the pull-off wires. And (3) that where the section to be protected is a down grade, the driver of the car, although he has his brakes on, has to momentarily put his controller on after he has passed the section insulator in order to operate the signal at the far end.

On the whole, the second class, in which the mechanism of the signal is actuated by a shunt current, seems the most practicable.

In this the trolley wheel, or head, of a car entering a section makes a momentary contact, which operates and locks the signal at the far end at "danger," and as it goes off the section it makes a second contact, which releases the signal. Two auxiliary signal wires must be run, preferably underground, but if this is not possible, then on porcelains attached to the poles.

Let us now briefly look at the case of two or more cars entering a section in the same direction (and this is where tramway practice differs from railway practice, for in the latter case, when a train enters a section the signal behind it is put and locked at danger).

Of course the first car will make contact and operate the signal, and will drop it when it goes off the section, but if the following cars are close behind this will not matter, as they will be in sight. The real difficulty arises in the case where a second car enters a section just *before* the first car has left the same section, the cars being out of sight of each other. The first car drops its signal as it leaves the section, although the second car is still on the section.

To obviate this would mean a great complication of the signal, and the provision in it of some mechanism by which the signal is locked until the same number of contacts have been made on its releasing gear as had been made on its operating gear. Such complication is to be avoided in an apparatus that has to stand all weathers, and is subject to continual vibration when fixed on a pole. The only way out of the difficulty seems to be that in such a case the cars should be so timed that they can go through a section in a bunch, or at any rate, within sight of each other, so that the driver of the first car can tell that of the waiting car how many he has behind him.

So far we have only considered the signalling for a simple piece of single track, but this latter method of automatic signalling with shunt currents is equally applicable to the more complicated case of another line branching out of the single track, which has to be protracted also.

Here in Halifax the writer has had to tackle the following special case, which may be of interest (see fig.).

Single track is laid from A to B, a distance of 490 yards, and mostly on a grade of 1 in 12; a single track branches off at C at a distance of 250 yards from A. There are loops at A and B. Signals are fixed on the poles marked *a*, *b*, *c*, and these poles are not visible from each other. Two signal wires are run from *a* to *b*, with tappings off to *c*.

A car entering the section at A, and proceeding to D, sets the signals at *b* and *c* at danger. When it reaches the pole on which *c* is fixed, both signals at *b* and *c* are released. A car going from A to B sets *b* and *c* at danger, and when it reaches a point *b'* (visible from *b*) it releases *b* and *c*. The reason for using this point *b'* is to obviate the necessity of a car going from D to A having to wait at C until the car going from A to B has reached *b* and released the signal at *c*. Of course, a car going either from B to A, or from D to A, sets the signal at *a* at danger until it reaches it and releases it.

Trouble has been experienced with drivers, who fail to see the necessity of not letting their trolley get on to a contact when their signal is against them, and so setting the distant signal at danger, and causing confusion. And again the driver of a car waiting at B, with signal against him, feels aggrieved if the car he is waiting for is an A to D car (because if he had known this, he could have dropped down to C and waited there until the A to D car had passed C). This, of course, is quite unavoidable unless there be a special contact arrangement which only the A to D cars will operate, and which would necessitate a second signal at B, and thus cause more complication and liability of failure.

In any case, it is obvious that cars at either end of a section may enter it simultaneously; hence it is necessary to have a preference rule. Thus, say, the down car has preference, and enters a section X Y at X, and an up car simultaneously enters the section at Y, then if the conductor at the rear of the up car sees the signal go to "danger" behind him, he must inform his driver, and the latter must back out and wait for the down car.

## THE PROLONGATION OF PATENTS.

The case of Wuterich's patent, in which an application for prolongation was made to the Privy Council on February 19th, illustrates the importance of a patentee keeping an account of profits in such a form as to enable the Court to decide whether the profits made have been sufficient to justify a prolongation. The petition was for a prolongation of a patent known as the "Biltor pipe," an invention which was designed to check the evils attendant upon smoking by preventing nicotine poisoning, and the consequent narcotising of the system. The inventor alleged that he

had spent large sums of money, and devoted great pains and labour in bringing the device to the attention of the public. With this object he had formed a company called "The Biltor, Ltd.," to exploit the invention, but without satisfactory results. It was stated, in opposition to the application, that the Crown had been unable to ascertain from the form in which the accounts had been kept what profits had been made from the patent cartridge as distinct from the pipes and tobacco sold in connection with it. Lord Macnaghten, in stating the opinion of the Court, said that their Lordships had been unable to discover from the accounts before them what had been the remuneration which the patentee had actually received. He continued: "The form in which accounts should be submitted in petitioning for the prolongation of a patent were stated by Lord Cairns in Saxby's Patent (L.R. 3 and P.C. 292) and by the Privy Council in other cases." In the event the petition was refused.

Having regard to the above case, it may be of interest to consider some of the cases where the Court has explained the manner in which the accounts of a patentee should be submitted.

It was laid down in the case of Perkins' Patent (2 W.P.C., 14) that the accounts presented by a petitioner should be clear and plain on the face of them. The patentee must not present ambiguous accounts, trusting that the Committee will unravel their meaning, as the Privy Council cannot undertake this task. In Saxby's Patent (*ubi supra*) Lord Cairns said: "It is the duty of every patentee who comes for the prolongation of his patent to take upon himself the onus of satisfying this Committee, in a manner which admits of no controversy, as to what has been the amount of remuneration which in every point of view the invention has brought to him, in order that their Lordships may be able to come to a conclusion whether that remuneration may be fairly considered a sufficient reward for his invention or not. It is not for this Committee to send back the accounts for further particulars, nor to dissect the accounts for the purpose of surmising what might be their real outcome if they were differently cast; it is for the applicant to bring his accounts before the Committee in a shape which will leave no doubt as to what the remuneration has been that he has received."

In spite of this emphatic statement, there are occasions upon which the Privy Council will depart from their general rule. Thus in Lake's Patent (1891, A.C. 240) accounts were presented which differed from the books which had been kept. It was stated that the books had been kept on a wrong system, and the Board held the accounts insufficient; but in giving the judgment of the Court, Lord Hobhouse said: "Their lordships do not mean to say that there might not be a case in which it would be proper to unravel and investigate accounts. Faults might have been committed, or there might have been some peculiarity of the business which would render that necessary by some proceedings, either here or with the aid of the Crown, before the parties arrived at this stage of the business; but then a special case should be made for that purpose. In this case the petition tells us nothing about the necessity of going through these operations; it does not explain why the books were kept in this way, or why it is now proper to alter the accounts; it does not even show that they are to be altered; it merely states that the petitioner is inadequately remunerated, and then lays the accounts upon the table, from which, as I said before, their Lordships cannot judge whether the fact is so or not."

Although it is often a matter of great difficulty to estimate the profits made by a patented invention which forms part of a complicated machine, it seems to be clear upon the authorities that the patentee must make an estimate before he can hope to succeed upon his application for an extension. For this purpose he should keep a separate account for his patent from the first, and as the Judicial Committee of the Privy Council presume that every patentee is aware from the very first that he may have to apply for an extension, they naturally expect that he will be prepared to show how he has benefited, or how he has failed to derive benefit, from the result of his ingenuity. In Willans & Robinson's patent (13 R.P.C., 550), the invention consisted of an adaptation of an air buffer to control the moving parts of high-speed single-acting engines. Upon an application for extension, very full accounts were presented by the petitioners. It was admitted, however, that the engines sold by the patentee had commanded a sale partly on account of another patented invention in connection with a valve which was used with them. No attempt had been made in the accounts to make any apportionment between the two patents and the profits derived from each. In spite of representations on the part of the petitioners that, owing to the nature of their business, it was impossible for them to make the distinction, the Judicial Committee refused to grant any prolongation, stating that on the accounts as presented, they could not hold that the remuneration had been inadequate.

In Thorneycroft's patent (16 R.P.C., 204) it appeared by the accounts that large profits had been made by the petitioners upon boilers supplied by them for ships built by others, but that on the boilers fitted into their own ships there had been a loss of 10 per cent. As no explanation was given of this circumstance, the Privy Council declined to recommend a prolongation. In delivering the opinion of the Court, Lord Davey said: "In the absence of any explanation, the facts proved are consistent with the existence of some error of judgment, miscalculation, or other defect in the petitioners' mode of carrying on their business of boat building, and their Lordships cannot accept the evidence as proof that no profit was, or could have been, made in working the patented invention."

Should the patentee have protected his invention abroad, he must disclose all the profits made abroad. Sec. 25 (4) of the Patents Act, 1883, provides that, in considering their decision, the Judicial Committee must have regard to the nature and merits of the invention in relation to the public, to the profits made by the patentee as such, and to all the circumstances of the case. In the recent case of Newton's patent (9 A.C., 592) it was argued that these words restricted the inquiry as to profits to the profits made by the patentee as such only, and that no inquiry as to foreign profits was necessary. The Judicial Committee, however, held that the words of the Section were indicative of one class of profits which had to be considered, and that at least they would go into the consideration of general profits as falling under the head of "all the circumstances of the case."

## THE "1903" REVISED RULES OF THE I.E.E.

(*Concluded from page* 605.)

*Resistances.*—Rule 71 lays down definite instructions regarding all resistances; apart from constructional points usually adopted in practice, they must be fixed so that no unprotected inflammable material is within 6 in. of the cases containing them, or within 24 in. measured vertically above them. More important is the rule that they must be proportioned so as not to rise more than 240° F., nor the cases more than 130° F. above the temperature of the surrounding air. The old rules allowed only 212° F. for the former figure.

*Choking Coils.*—Rule 72 specifies that these must conform to the same rules as resistances, but their temperature must not exceed 170° F.

*Accumulators and other Batteries.*—Rules 73 and 74 are practically the same as in 1897, but whilst batteries must be "protected by fuses at all points of connection between the circuit and the regulating cells," this is waived if "special precautions are taken to keep the conductors permanently apart by incombustible and non-conducting material."

*Transformers.*—Rule 75 states that the transformer must be protected by suitable apparatus, so as to cut it out of circuit if there is a leak between the primary and secondary coils. We only quote this necessary injunction, as the old rules qualified this by allowing the raising of the pressure to 400 volts above that of the earth before cutting out. Transformers must not exceed a temperature of 170° F. under normal full load, whereas the old rules allowed only 150° F., and also specified that their frames must be connected to earth; but this latter recommendation is now omitted.

*Electrical Cooking Appliances, Radiators, and Heaters.*—These apparatus are now recognised for the first time by Rule 77. They must be so constructed and mounted that

heat cannot be conveyed to their supports and connections. They must also be protected by a fuse and switch on *both* conductors (subject to Rule 5).

*Testing.*—Rule 78 defines the test without fittings (presumably this means without accessories also). "Points" are to be counted as the number of pairs of terminal wires from which it is proposed to take the current. The test should be at least twice the working pressure, and must not be less than $\frac{30}{\text{number of points}}\ \Omega$. After connecting all the fittings, the test between conductors must be not less than $\frac{25}{\text{number of 30-watt lamps}}\ \Omega$; the same test holds for insulation to earth after inserting lamps and fuses. Every arc lamp shall be considered equivalent to 15 lamps, and motors and heaters shall be rated as one lamp per ampere provided that the insulation resistance to frame is more than 500,000 ohms. The old rules specified $\frac{10}{\text{maximum amperes}}\ \Omega$, which works out that the new rules are stricter than the old in the ratio of 2 : 1·25.

This completes the actual rules, the remainder of the pamphlet consisting of the table, its explanation, some definitions, and a short appendix giving a few useful figures regarding the resistance of copper. Speaking generally, it does not appear as though the rules are sufficiently revolutionary to cause any inconvenience or trouble to those who will have to use them. The best points of the various important rules in vogue seem to have been embodied, and where novelties have been introduced, it may be said that they were practically already unwritten law from the result of experience. The Committee have refrained to a certain extent from expressing so many general opinions as in 1897, and perhaps this is a good fault, for the rules will have to be used by many who, having been responsible in the past for rules of their own, may object to a statement of opinion whilst admitting a statement of fact.

The rules form an important milestone in the progress of electrical industry, and it is to be hoped that the Committee will receive the best of all recognitions for their labours, namely, the knowledge that the rules are universally used and appreciated.

## NEMESIS.

The spectacle of a community stewing in its own juice is not a pleasant one, and we regret to say that Wolverhampton presents us with that spectacle at the present time. It would be false to say that we are altogether sorry for Wolverhampton in its present plight, because we hope that the results will be salutary, and that the lesson to be learnt will be digested, not only by the town chiefly concerned, but by those towns which are near the fire, but have not yet been burned.

Beginning in a mild way with a mile of route equipped on the surface-contact system, the Corporation instructed the Lorain Steel Co. to complete the equipment of the remaining 10 miles of tramways after the *satisfactory commercial operation for 30 days* of that first mile. This was in accordance with the terms of an agreement between the Corporation and the company. On all hands we are supposed to be endowed as a nation with keen commercial instincts, and the ardent municipal trader is never tired of asserting that the members of a Council contain more of those instincts per pound than any collection of specialists, yet we find the Council of one of the most important commercial towns in one of the largest commercial districts in England, entering into an agreement permitting an absolute novelty in electric traction to be called a commercial success after it has been in operation for one month!

This policy met with the strong disapproval of the Electrical Review directly it was known; but the warnings of the technical Press, and the non-committal attitude of their own engineer, were not heeded by the Council.

We have been favoured with a copy of the report of the borough electrical engineer on the year's working, which we have read with considerable interest; and we have to congratulate Mr. Shawfield on the result of his careful labour.

A supplementary report from the borough engineer on the granite casings of the contact boxes, with some remarks on the permanent way, is added, and the whole production is a complete vindication of our views.

The position of the electrical engineer has been unenviable throughout, but it must be confessed that the interests of the public might have been safeguarded better if he had refused in the first place to seriously consider the engineering aspect of a new system on which he would have to report definitely in one year's time.

The report opens with the reminder that, when first asked by the committee to give an opinion on the operation of the experimental mile, he stated that he could express none until the system had been in commercial operation for at least one year, although the very report in which this statement was included was worded in such a manner as to give the ordinary councillor, especially any councillor who was predisposed to the Lorain system, a favourable impression of that system, as compared with the overhead system.

The terms of the agreement with the Lorain Co. must have been well known to the engineer when his first report was presented. He must have known that after 12 months' working, the Lorain Co. were to have a yea or nay, and then was the only time to have made the ridiculously short period of probation the *text*, and not merely a kind of postscript of his report. We have no sympathy, therefore, with the engineer when he says at the end of the present report that "the responsibility which has devolved upon me of having to give a definite opinion from an engineering standpoint as to the success or failure of a system of electrical traction which has only been in commercial operation for one year is very heavy, especially as circumstances require that I should also give an estimate of the future annual cost of operation . . . ." This heavy responsibility should have weighed with him when it was first proposed to stake the ratepayers' money on an experiment. A strong word at that time would have made the greatest faddist among the Councillors think again before taking a course in opposition to the opinion of their expert.

We have to take exception, too, to the off-hand way in which the engineer thrusts aside the least commercial responsibility. In the paragraph quoted above he speaks of having to give a definite opinion from an *engineering* standpoint, and, in the next paragraph, he states explicitly that "the responsibility for deciding whether or not the advantages offered by the Lorain surface contact system are commensurate with the extra expense involved, rests upon the Tramways Committee and the Council." Strictly speaking, that is quite true, but it is just as true that the Committee and the Council have to take the ultimate responsibility for deciding the engineering question as well.

The report is taken up mainly with the consideration of the following points:—

1. Safety to human beings and animals.
2. Reliability.
3. Consumption of energy.
4. Cost of working.
5. Cost of maintenance.

Under the first heading it is found that the studs offer no particular obstruction to traffic, nor have there been reported any accidents caused by persons or animals slipping or stumbling on the top plate, but a very significant sentence, to be found under "Paving" in the borough engineer's additional report, should be read with these statements. He says that, contrary to expectations, there has been no extraordinary wear of paving around the contact boxes, "owing largely, in his opinion, to the fact that the tracks are avoided to some extent by the general traffic in the streets." Doubtless this throws more light on the fact that, although there were 109 boxes found "alive" between May, 1902, and February, 1903, only five of these boxes were the causes of shocks being administered to living things. From our own knowledge we can assert that traffic does avoid the studs most noticeably, and after driving through the town in a hansom, which, by reason of its overtaking power was forced

to travel on the tracks for considerable distances, we should say that the reason for this avoidance is not so much the fear of shock, as a natural aversion to being jerked out of one's seat at every 10 ft. Probably, too, the owners or drivers of vehicles have some regard to the depreciation of their property.

One of the questions now before the people of Wolverhampton is whether they prefer to run the risk of shock from a live trolley wire which they can see, and know to be dangerous to touch, or from an innocent-looking iron plate, about the electrical state of which they can tell nothing until they step on it.

Mr. Shawfield, himself, states that he does "not think it feasible to devise or construct a surface-contact system in which there is absolutely no possibility of a stud being alive except when a car is over it . . . . ;" but he is of the opinion that a consideration of the facts accumulated during the year "justifies the conclusion that, although with the Lorain system there is probably a somewhat greater liability to shock, there is distinctly less risk of serious injury to users of the streets. . . ."

To us, however, a consideration of the same facts leads us to the conclusion that the first few weeks of working may result in many boxes becoming alive, because one can never be sure that supervision has been keen enough to ensure the parts being properly put together, and the whole box well laid; and that for ever after any box may break down by reason of a short circuit at that box, while it seems probable that continued exposure for several years will lead to a gradual deterioration of the watertight properties of the box.

Mr. Shawfield's statement that a falling trolley wire is likely to come into contact with bare flesh, if it happens to strike any one, and will give probably a more serious shock than could be obtained from a contact stud, may be quite correct, but we would ask for very much more definite statistics than the number of emergency calls per annum in three large towns, to prove that trolley wires do fall frequently, or, when they fall, do any personal damage. As a matter of fact, considering the number of miles of overhead work in England, the amount of breakage is very small, and the number of accidents is infinitesimal. On the occasion of extraordinary snowstorms regrettable accidents have occurred, but the fault has never lain primarily with the overhead system. That trolley wires do break occasionally is incontrovertible, but it is of the extremest rareness for a wire to strike anyone in its fall. Once down, either the current is cut off automatically, and the wire is innocuous, or users of the street take particular care to avoid it, and a host of motormen, conductors, inspectors, policemen and firemen are on the spot almost before the wire has fallen, to guard it. On the other hand, unless a live stud is discovered in time by the itinerant tester, it is made known only by its shocking effects on horses or pedestrians.

Under the heading of "Reliability," Mr. Shawfield has been able to make out a very good case for the Lorain system, as he shows that the percentage of miles lost, due to defects in the Lorain system, was ·13 per cent. In fact, there is little reason why the reliability of such a system, for the first few years at least, should not be as great as the reliability of the overhead system. After a time, however, comes the trouble with the track, which has to be kept perfect if any contact system is to operate satisfactorily. This point was made in the REVIEW of April 4th, 1902, and this is what the borough engineer (Mr. George Green) has to say on the subject. " . . . In the ordinary course of events, the fact of the rails being loose would not prevent an overhead system from working in the usual way, except, of course, the rolling stock would suffer in proportion to the defective condition of the track. . . . Should the rails sink or become movable to any appreciable extent with the surface contact system, difficulty might arise through the skates and magnets coming into contact with the boxes or the surface of the paving. . . . It is more than possible the rails will become loose to some extent as the track increases in age. . . . It is very difficult to put a figure as to what this may cost, as the possible wear and tear is an unknown quantity . . . . and an estimate can be only a matter of speculation." Yes! it should be a matter of very serious and uncomfortable speculation for the ratepayers. The Wolverhampton Council and their officers have had little experience with a track even three years old, and we wish them every joy if they elect to add to the usual experience by keeping contact boxes in the centre of the track.

Under the heading "Consumption of energy per car mile," Mr. Shawfield shows that on this count alone the Lorain system is a most expensive luxury, for careful experiments and calculations gave the following data :—

| | | | |
|---|---|---|---|
| 1. Excitation of magnets ... ... ... | ·111 | unit per | car-mile. |
| 2. Extra weight of Lorain car equipment ... | ·131 | " | " |
| 3. Leakage current ... ... ... ... | ·008 | " | " |
| Total ... ... | ·250 | " | " |

The average consumption of energy per car-mile with the Lorain system has been 1·4 units, and by deducting ·25 unit from this average, Mr. Shawfield arrives at 1·15 units as the average consumption per car-mile if the overhead system were in use; but we cannot help thinking that there must be some other extras, of which Mr. Shawfield has not thought, to be charged against the Lorain system, for on the average Wolverhampton route the consumption per car-mile should not exceed 1·05 to 1·10 units. As we cannot prove this, we must accept Mr. Shawfield's 22 per cent. extra as correct; and we would suggest to him that such an inefficiency will go a long way to write off any economies which he has been able to make in the generating station since he started.

"Assuming that the average price paid for electrical energy in the future will be 1·65d. per unit, the additional cost in electrical energy consumed by the Lorain system will be ·41d. per car-mile"! In other words, the people of Wolverhampton may have to pay as much extra for energy alone as the ordinary tramway has to pay for the whole of its car repairs and maintenance.

Although outside the present subject, we would direct attention to the price which the Tramways Committee are paying for their energy, presumably to the Lighting Committee. Here we have the seeds of a common municipal transaction. Notoriously the Wolverhampton lighting undertaking has not been a financial success, although the latest doctrine dinned into our ears is that profits in relief of rates are not to be considered in municipal schemes; but the inclusion of the tramways among its consumers at 1·65d. per unit should enable a fine fictitious profit to be "earned" in future. If this rate held during the last year, we estimate that the Tramways Committee have paid at least 33 per cent. more for their supply of energy than they should have paid.

Coming back to the report, the next heading is No. 4, "Cost of Operation," and this, apart from the consumption of energy, will be the same for either system.

The last section is the most important, covers the most space, and should convince anyone who still requires convincing, that the Lorain system cannot be a commercial success in the usual acceptance of that term, not as defined in Clause 19 of the agreement between the Corporation and the Lorain Co. (ELEC. REV., Vol. lii., p. 528).

Mr. Shawfield recognises that "in estimating what the cost of maintenance will be, it is obvious that the figures obtained from the first year's operation cannot in themselves be regarded as a satisfactory and reliable basis." For that reason he has endeavoured to form an *accurate* estimate of the average annual cost of maintaining the system by determining the *probable* life of the component parts, and the *probable* cost of replacing those parts when worn out or damaged.

Considering that, with the exception of the cables, there is only a first year's experience and some laboratory experiments to work with, there is at least room for speculation as to the degree of accuracy obtained.

Incidentally a sentence in this last section has disclosed the fact that there are 1,090 soldered and insulated cable joints per mile of track laid—12,000 in all!—and Mr. Shawfield is optimist enough "to think that not much further trouble may be looked for in this direction."

We cannot criticise the maintenance and renewal estimates for the contents of the "box of tricks" in the road, or of the magnets, batteries, switches and collecting skate on the car; but we desire to draw attention to the experience already gained with the contact plate. This is the casting which forms the lid of the contact box, and supplies current to the skate. The wear has been so

excessive that the average life is taken as two years only, so that the renewals work out at 1·12d. per car-mile.

Mr. Shawfield makes a definite statement here that this cannot be considered satisfactory, which comes as a relief after no expression of opinion at all on the abnormal consumption of energy, and the indefinite statement that "on the score of operation, there is very little to choose between the Lorain system and the overhead system."

The Lorain Co. have brought out a new type of top-plate with a renewable centre wearing piece, and we presume that the system will be given another year's trial to demonstrate the accuracy of the revised estimate, which brings down the cost of maintenance to ·094d. per car-mile. Even if we accept this figure it means that an annual expenditure sufficient to pay interest on the cost of four to five new cars will have to be borne for the æsthetic delights of the Lorain system. That calculation is based on the mileage run last year, and, of course, the charge for which there is no equivalent on the overhead system, will increase with the mileage.

The figures given respecting the collecting skate are of interest, as there was considerable outside discussion about its average life. Starting at only 800 miles in May, 1902, the skate appears to have been improved continually, until in February this year the average life was 4,525 miles, and it is stated that the average life in future will not be less than 6,000 miles.

Let us consider the skate in the light of the trolley wheel. The cost of the first is £1 10s., and of the second 2s. 6d., and often less, so that the lives should be in the ratio of 12 to 1; but we find in actual practice that a trolley wheel will run as much as 5,000 to 6,000 miles as an average on a straight under-running system. Lorain worshippers therefore must put some more in the plate—an amount equivalent to ·06d. per car-mile, or interest on another three revenue-earning cars on the basis of last year's mileage.

The electrical engineer's report closes with a kind of apocrypha, in the form of a table showing the comparative costs of maintenance of the two systems under discussion, followed by a general balance and conclusion.

The table first deals with the surface-contact equipment as compared with overhead equipment, and a footnote explains that the figure of ·216d. per car-mile for maintenance of all overhead work "represents the average cost of repairs and upkeep in the case of 15 towns from whom I have obtained information." In regard to these figures we take it that the owners of the lines were the municipal authorities in all cases, for no company could exist if the waste in all departments were as enormous as this. Has not a printer's error crept into this ·216d.?

We have investigated the matter very carefully, and we find that, for five companies dispersed over England, the total cost of *distribution* for one year varied from ·058d. (three cases) to ·081d. per car-mile, the latter being for one of the oldest trolley lines in England. These figures include everything which Mr. Shawfield has taken into account, and the maintenance of all cables in addition, yet none of them begin to approach the figure given by Mr. Shawfield.

Again, eliminating the cable charges from one of the largest of the above systems, we find that the average cost of maintenance of overhead equipment over two years comes out at ·039d. per car-mile (·045 and ·033). That system has been in operation for several years, and includes a variety of styles of overhead construction, some by no means of the best. The discrepancy is too large to pass, as it means a difference of nearly £400 per annum in disfavour of the overhead system, taking Mr. Shawfield's estimate of annual mileage with present length of line as the basis of the calculation. Similarly, although we have no figures to our hand at the moment, the ·100d. per car-mile allowed for future annual renewals (based on £20 per mile of single-track per annum) is too high, but in making our amended comparison, we will take this figure as it stands. The same indulgence cannot be permitted with the figures representing the cost of maintaining the collecting apparatus on a trolley car. This is stated to be ·064d. per unit, whereas the actual figure is about ·020d., or a decrease on the same mileage of nearly £100 per annum.

Then follows the comparative cost of energy for the two systems, and we think this too high, because, as stated above, we believe the estimated units per car-mile to be excessive.

Making the alterations detailed above, we obtain in place of Mr. Shawfield's table the following:—

| Lorain system. | Total cost in pence per car-mile. | Overhead system. | Total cost in pence per car-mile. |
|---|---|---|---|
| Track equipment ... | ·569d. | Overhead work ... | ·139d. |
| Car " ... | ·230d. | Car equipment ... | ·036d. |
| Electrical energy ... | 2·310d. | Electrical energy ... | 1·900d. |
| Totals ... | 3·109d. | | 2·075d. |

Thus bringing the overhead system as much as 1·034d. per car mile below the Lorain costs. Then:—

| | |
|---|---|
| 1. Annual car-mileage with present length of track ... | = 533,500 |
| 2. Annual car-mileage with extended track, as scheduled in Parliamentary plans ... ... | = 710,000 |
| 3. Extra annual expenditure on (1) if Lorain system be adopted ... ... ... ... ... ... | = £2,300 |
| 4. Ditto, ditto on (2) ... ... ... ... ... | = £3,060 |
| Total ... | £5,360 |

These figures do not include interest and sinking fund on the extra capital expenditure called for by the Lorain system, and the famous Clause 19 stipulates that no regard is to be taken of this amount; but, "for the information of the Committee," Mr. Shawfield gives the extra capital expenditure as £1,250 per mile of single track, the interest and sinking fund on which, at 4·66 per cent., amounts to £58 per mile of single track per annum.

| | |
|---|---|
| On routes already constructed this amounts to ... | = £696 |
| " remaining to be constructed ... ... | = £754 |
| Total ... | £1,450 |

As they stand at present with regard to track mileage, the combination of the above figures shows that the people of Wolverhampton will have to pay a premium of £3,000 per annum for the privilege of being peculiar; while, if they go to the full extent of their Parliamentary powers, they will smile, doubtless, as they hand over £6,810. Even the "profit" on the electricity works will hardly suffice to balance the account!

On the other hand, if Wolverhampton likes to risk the experiment, she will have the chance of finding out for herself if the improvements in the construction of the top plates and of the granite casings, which have still to be tried in practice, will come up to the expectations of the borough and electrical engineers, so reducing the annual extra expenditure by £1,240 to £5,570.

How many chairmen of tramway companies are longing for just the amount which Wolverhampton is eager to waste? It would pay a nice little dividend on an ordinary capital of £200,000.

This article is so long already that it is not possible to deal further with the borough engineer's report on the track except to say that out of 6,212 boxes fixed, 2,296 are in good condition, 2,479 are slightly damaged and worn, and 1,464 are badly damaged and worn; and with the exception of one route the average life of these boxes is estimated at three years. Of course, as we might expect, an improved *design* has been prepared which will make everything everlasting. We know those designs.

As reported in our "Traction Notes" the week before last, the last Committee meeting broke up without arriving at any decision, but that must come sooner or later; and if it is in favour of the present system, then, with no yearly Exhibition to inflate the receipts, there is every prospect of an increase in the present rates of 9s. 3d. in the £; if the decision is adverse to the system the people of Wolverhampton will find that the "Old Man of the Sea" is not to be compared to the Lorain Co. for tightness of grip. Indeed, who would blame them, when they have Clause 19 of the agreement for a whip? That clause "defines" a commercial success, and at the same time removes the last ground for thinking of

the Committee who passed it as possessing the veriest glimmer of commercial instinct.

Although the paper itself is of little intrinsic value, that on surface contact systems recently read before the I.C.E. (Birmingham Section) by a professed believer in one of them, is of interest in connection with the present article, as it points out the weak places found in working such systems.

Current being conveyed to the collectors entirely by insulated cables having a vast number of junctions, and therefore potentially weak points, extreme care has to be exercised in laying and jointing to avoid the effects of moisture and gradual loss of insulation. So serious is this that M. Bornand, who is certainly an authority on the whole subject, thinks that a great improvement would be the constant and forced ventilation of the tube or conduit into which the cables are drawn. He states that armoured cables enclosed in cast-iron pipes have to be used, but the Wolverhampton between-rail cables are laid on the solid system.

"The recess in which the switches are located should be as watertight as possible, especially in the system where the switches are placed underneath the metallic plates (contact studs)—very unfavourable conditions, indeed, for these switches cannot possibly be seen at any moment or promptly examined, and they are required to work satisfactorily during a number of years in a ground directly exposed to all the changes of the atmosphere, and under the sudden and variable conditions of load of a tramway service." The Lorain contact boxes are open to those objections, and the experience gathered in Wolverhampton proves that they are not groundless.

"The switch recess must be made of incombustible materials;" and we would add that, if it were possible, everything in the recess should be incombustible, too, so that the fireworks seen occasionally in the Wolverhampton streets might be avoided.

M. Bornand states that the insulation of the stud should be as perfect as possible, but that this condition is unattainable in ordinary streets. More or less serious leakage has to be expected, therefore, and it is quite possible for it to become so large—perhaps from the accretion of scrap iron or metallic particles, or from the introduction of moisture to the interior of the stud box—as to allow an arc to persist between the two switch contacts after the collecting skate has passed. That kind of thing has occurred frequently at Wolverhampton, particularly at points and crossings, and under the same conditions must continue to occur with that system.

The exploiters of the system appear to have admitted from the first that the first cost, the cost of maintenance, and the consumption of energy would all be higher than with the trolley system; exactly how much higher still remains to be seen; but one of the most striking features was its absolute safety. Alas, for the Lorain system! The best that can be said now on that score is, "Well, trolley wires come down and give people shocks, don't they?"

That beauty spot having been washed off, all that remains is the stock remark about the beauty of a row of studs compared with a row of poles; and, if the people of Wolverhampton are content to pay extra rates for the sake of the studs, then it is really "none of our business," and we can only leave them with the thought that the Council and the Tramway Committee will never lack men in whose crania the space provided for commercial intelligence is swept and garnished. We are confident, however, that the people will stand the trolley, and worse, if they can keep their pockets closed, so that we shall look for the publishing of the complete report and balance-sheet with the intention of further criticism.

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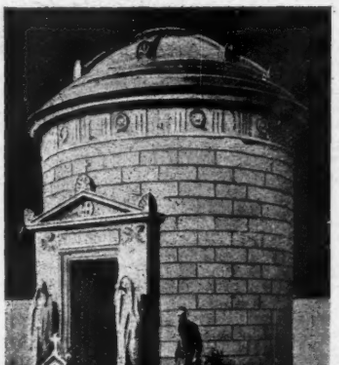
**Bradford Tramways.**—The Corporation has decided to proceed with the construction of sidings and connecting lines at a cost of about £7,000. Mr. C. W. Shepherd, the tramway traffic superintendent, has been appointed to a like position in Edinburgh at £300 a year.

## THE INSTITUTION OF ELECTRICAL ENGINEERS IN ITALY.

(*Continued from page* 625.)

At the Tomb of Volta, the visitors were received by Cavaliere E. Linati (Mayor of Como), Prof. A. Volta (grandson of the great philosopher), and other distinguished gentlemen. The members of the party reverently bared their heads as they entered the little cemetery of Camnago Volta, and stood



The Tomb of Volta.

before the mausoleum which had been erected to the memory of Alessandro Volta and his family. Cavaliere Linati then addressed the assembly in Italian. The following is a translation of his speech:—

Ladies and Gentlemen,—In this hour of profound emotion, my poor inadequate words ought only to express the gratitude of Camnago Volta for the momentous visit of this noble assembly, before which I reverently bow. Yet I cannot but elevate my thoughts to the cause of this high honour—to that great one who, consecrating this hill as monument to his eternal repose, left it a heritage of honour and glory, which you, with your illustrious presence, magnify. Yes; Alessandro Volta, to whom humanity owes that great revelation that tore the veil of ignorance from the dying eighteenth century, and who illumined the world with his sparks, pointed out to science the upward paths to tread. Fervent apostles of physical research, with skilled and modern applications of his discovery, have astonished the world and immortalised his great name.

It is not, however, given to me to enter further into this subject, as it is too elevated for the scientific attainments of the speaker. Therefore I close these few words, recalling how, four years ago, on this selfsame tomb, the renowned Prof. Thompson (who, I am glad to see, is among us again) bore the greeting of the English Electrical Engineers, a greeting that I beg to exchange to-day, with fervent affection, in homage to the science that, above every human passion, has made us brothers at this sanctuary.

I thank you again, ladies and gentlemen, for the honour rendered to the modest Commune of Camnago Volta, that will brand this memorable day with indelible, grateful and perennial memories.

The President of the Institution, Mr. R. Kaye Gray, then spoke as follows, in the French language:—

In the name of the Institution of Electrical Engineers of Great Britain, and during the presence in Como of over 120 members of this body, I lay a wreath on the tomb of Volta, as a mark of veneration for one whose fame has lasted for more than 100 years, and whose philosophic thought and indefatigable industry have rendered great services to mankind.

Mr. J. Gavey, Vice-President of the Institution, and Engineer-in-Chief of the British Postal Telegraphs, also addressed the assembly in French to the following effect:—

I much regret my inability to address you in your beautiful Italian language, and, further, it is impossible in any language to do justice, in a brief address, to one who may be said to have laid the foundation of our modern electrical engineering. I simply, therefore, content myself by asking you to accept on behalf of the Institution of Electrical Engineers of Great Britain the assurance of the deep feeling with which we pay homage at the tomb of the great Italian Volta, a man whose name is honoured and revered throughout the civilised world. That his spirit still lives amongst

the inhabitants of his native land, and that his mantle has fallen on worthy shoulders is shown by the carrying out of the great electrical works which we Englishmen have travelled so far to see. That this spirit of enterprise may continue, and that it may result in the further development of the resources and in the increase of the prosperity of this magnificent country, is the fervent hope of your friends and well-wishers, your English visitors.

Prof. Silvanus P. Thompson delivered an address in Italian, of which the following is a translation :—

Honourable Mr. Mayor, eminent colleagues, members and friends,—We have come here to offer our respects to the immortal memory of a man whose name is kept in perpetual reverence by all the civilised world. Here on the Italian soil, under the beautiful sky of Italy—Italy, the mother of nations—we pilgrims, sons of another country, born under another sky among the grey fogs of the north, we wish to add to the homage of other nations our tribute of faithful and everlasting memory.

It is perhaps superfluous to lay stress on the intellectual obligation due from science, and much more from practical science, to Alessandro Volta. His name will remain eternally associated with the inventions of the Electrophorus and of the Voltaic Pile. Truly he was more than an inventor: he was a scientist of the first order, an investigator of great genius, who accomplished many conquests in many departments of physical science, who did many things, but who touched nothing without adorning it.

In the course of his laborious studies, in the midst of his duties as professor of the University, he made celebrated discoveries relating to the source of the electric current, beginning with the electric pile, which he invented. He is honoured as a great inventor, as an apostle (one may say) in practical knowledge, who by his intellectual power mastered the rough forces of nature, and converted them afterwards to the service of human civilisation. Since the invention of printing, which multiplied learning and the diffusion of ideas, and, later on, the invention of steam as a motive power, which not only multiplied industries and the mechanical power of man, but also quickened and facilitated the contact of people with people, the progress of civilisation and of science has equally multiplied and increased. But no other discovery contributed so much to the perfection of arts as that of the Voltaic Pile, which we owe to Volta. Without this initial discovery we should not have had the discovery by Faraday of the electric rotations, the beginning of the principle of the electric motor, a discovery followed many years after by the discovery—much more important—of induction, the principle, in fact, of all dynamos and transformers. With the continuous development of science we have arrived at the knowledge of many things unknown at the time of Volta. All the phenomena of electromagnetism, the mechanical generation of electric currents, the transmission, distribution and utilisation of electric power, telegraphy and telephony, the new horizon of electric waves, all appeared in the last century, after his death. The fundamental principle of all these wonderful developments was due only to this great man. In all these developments Italy has taken a great part. Italy has never ceased to produce worthy successors to Volta in electrical science, as well amongst those who carried forward the torch of research as amongst those who made use of the forces of nature for the advantage of man.

We are happy to know, and we congratulate ourselves with you, that the developments of electrical industry in Italy have greatly contributed to the prosperity of this great country, and we modest followers of those studies which Volta so grandly made, realising the greatness and immensity of this new world opened up by him, we come to his tomb to salute his memory. At the same time we make this homage to him, and to the memory of those true splendours of past centuries, by which Italy acquired the well-merited name of "the land of the great." We remember, too, that we are also citizens of a nation where science flourishes with great development, and where, from time to time, great personalities have lived. If Italy can boast of the names of Galileo and of Leonardo da Vinci, we can also boast in England of Gilbert, the father of magnetism, of Newton, the creator of natural philosophical mathematics. You Italians have Volta; we are proud of Faraday. But neither Galileo nor Newton nor Volta nor Faraday belongs exclusively to any one nation. Great men of such a kind belong to the whole world, and we pilgrims of science gather once more around the tomb of Volta, the greatest benefactor of humanity, in order to render our tribute of reverent knowledge and of universal recognition.

Prof. Volta, who occupies the Chair of Physics at the Liceo, Milan, also addressed the meeting in terms of which the following is a translation :—

Ladies and Gentlemen,—In coming to Italy on your long scientific tour, you did not forget the Comasco electrician, and have brought a splendid crown of art to the tomb where he reposes. Permit his descendant to remark that this is but a continuation of the noble relations that tied his life to learned England.

The great Volta searched and found in England wide fields of culture; Crawford and Black were his favourite authors; he spent many months in your country in the year 1782, and while there he became acquainted with its great and numerous industries, and had occasion to see the first railroad at Coalbrookdale, of which he wrote enthusiastically to Italy. He visited the most renowned academies, and was friendly with such men as Priestley, Watt, Percival, Cavendish, Banks, Davy, and many others; and he ultimately showed his respect for English science by giving his first academical lecture at the Royal Society in London in the same year, reading his famous memorandum on the electrometer condenser invented by him—that simple yet marvellous instrument that was the first stepping-stone to the great discovery.

The Royal Society appreciated the merit of Volta, and seven years before the invention of his cell, it had already nominated him effective member of the Society, almost as a prelude to his immortal discovery; and it was even so, for, before communicating to any other the invention of his cells, Volta first of all wrote of it to the Royal Society in his classical letter dated March 20th, 1800, addressed to the President, Sir J. Banks.

To-day history repeats itself; a young Italian, willing and worthy, proposes to himself a problem such as only those who have the strength to win, can achieve; and behold, in England he finds help and support for his first faltering steps that quickly become enormous strides; for, if Marconi had not the moral and material encouragement of Preece, he might never have won, or at least, his victory had been much delayed.

I take pleasure, ladies and gentlemen, in recalling all this here, and at this moment when you confirm these sentiments that your noble country professes for the studious, no matter to what nationality they may belong.

It is these that impart to your gracious homage to Volta an immense value and particular meaning, and I am glad to express these sentiments while I beg to offer you my sincere and affectionate greeting.

Mr. J. R. Hewett, on behalf of the students of the Institution, was charged with the duty of offering a memorial tablet subscribed for wholly by the students. Mr. Hewett spoke as follows :—

Ladies and Gentlemen,—Representing, as I have the honour to do on this occasion, the student members of the Institution of Electrical Engineers, I beg to present the memorial shield of bronze, designed by Mr. Gilbert Bayes, and subscribed for by the students, as a token of the deep respect in which we revere and honour the memory of the great Italian inventor, Alexander Volta.

It is interesting to mention that Mr. Bayes is a Gold Medallist of the Royal Academy, and was formerly an Art Student at Finsbury Technical College.

The ceremony of presenting the wreath, and the accompanying speeches, were performed with great decorum and solemnity, the only regrettable feature being the excess of zeal displayed by some of the numerous amateur photographers of the party, who kept up a continuous fusillade of snap-shots all the time. At the conclusion of the ceremony most of the party reverently passed through the Tomb. Afterwards the members were entertained with light refreshments at the house of the Mayor, Cav. Linati, before driving back to Como.

On the return journey, a most unfortunate accident took place; one of the vehicles was partially overturned, and Mr. C. J. Hall, of Leeds, had the misfortune to break his arm. Mr. Hall pluckily declined to become an invalid, and went on to Milan on the following day; during the week the patient made fair progress, but, of course, some weeks must elapse before his injury is cured. No other member of the party was hurt.

The afternoon was free of engagements, and the party was dispersed abroad over the town and its environs. Many of the members went up the Brunate, an imposing mountain almost overhanging the city, by funicular railway, and those who continued the journey on foot to the summit were rewarded by a panorama of great beauty. At 5 p.m. a reception was held at the Civic Museum by the Mayor, who entertained the visitors to tea; in this Museum are preserved the Volta relics and many other interesting objects.

The Museum, Casino, Public Library, the Exhibition of Agricultural Machinery (which opened on the 5th inst.) and the funicular railway were all placed freely at the disposal of the visitors, who were greatly indebted to the extreme courtesy of the Municipality of Como, and the Mayor, Cav. E. Linati.

In the evening a number of the local dignitaries joined the members of the party at dinner at the Plinius Hotel, the function becoming, in fact, a farewell banquet, at which many brief speeches were delivered, expressing in the warmest terms the mutual respect and esteem of the visitors and their Italian friends.

On the following day an early start was made for Milan.

(*To be continued.*)

## CORRESPONDENCE.

### The Manchester Electrical Fish and the Valparaiso Mule.

I thoroughly appreciate your Valparaiso correspondent's letter in this week's issue of the Review, but I think that the electric fish as brought to land by an electrical fisher at

the Manchester meeting is too valuable a prize to be in any way injured by the kicking of any mule, not even by one kicking all the way from Valparaiso. Now that I think of it, the Valparaiso mule could have no kick in it, seeing that according to its inventor its legs work through stuffing boxes in the bottom of the boat.

The account in your issue of February 26th (?) does not do justice to the inventor of the electrical fish at the Manchester meeting. Some may think as your Valparaiso correspondent evidently does, that the fish was of the electrical cod species. The conception is certainly full of humour, but it was evident from the details given by the speaker, that he had a sound grasp of the difficulties to be overcome in adapting electric power to the haulage of canal boats, and that he saw a practical possibility of constructing an electrical fish for that purpose. That it will be a fish difficult to catch goes without saying, but it is to be hoped that the inventor will follow out his idea, and finally give us "The Compleat Angler," in the shape of a fish no disciple of Izaak Walton ever dreamed of.

If, therefore, the electrical fish can rank on its humorous side with your Valparaiso correspondent's mule, and inclined plane suggestions (*vide* Max Adeler), the fish is capable of useful work in the future, while the mule must inevitably stick in the mud.

**Aquatus.**

P.S.—In view of your correspondent's remarks on the size of the boat, the inventor of the fish suggested that a fish of the nature of a torpedo with two propellers running in opposite directions would not run any danger of rotating rapidly round an almost stationary propeller.

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### efuse Destructors.

Will you permit me a very few words in answer to Mr. Gray's criticism in your issue of the 3rd inst. on my letter in your issue of March 27th? I am pleased to note that Mr. Gray confirms the figures of evaporation which I gave. I fail, however, to follow his argument with respect to the different qualities of refuse consumed at different times.

So far as I have been able to find out there is only one quality of refuse in Accrington, and it is not selected in any way with a view to steam raising.

With regard to Mr. Gray's second point, my reference was distinctly to the units generated per ton of refuse. I do not think that the destructor is concerned in any way with the units delivered.

The object of my letter was to point out to you that the results obtained at Accrington in the generation of electricity from refuse are equal—if not superior—to those obtained on any other plant in existence, and I feel sure that Mr. Gray will not quarrel with me for wishing to make this fact clear.

I quite agree with his concluding remarks with regard to the publication of exaggerated figures, which I have always deprecated and carefully avoided.

**F. L. Watson, A.M.I.C.E.**

Leeds, *April 7th*, 1903.

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### On Coherence.

I have read with much interest "W. P. B.'s" article on the above subject, but do not consider his theory is sufficient to meet the case. Taking the amount of extension of the filings given by him at $\frac{1}{800000}$th part of their length, he assumes that the increased space occupied by the filings sets up compression, and hence better contact; but let him take a tube of filings which will cohere under the influence of electrical waves, having a movable plunger as an electrode in good contact with the filings, and let him compare—

1. The decrease of resistance under the influence of waves.

2. The decrease of resistance caused by compressing the plunger $\frac{1}{800000}$th of the space occupied by the filings.

He will find the decrease in Case 1 is far the greater.

I suggest the following theory as giving a more consistent explanation:—

It is known that substances in an electro-magnetic field become radio-active; suppose, then, that the filings either in a magnetic field, or what is practically similar, in the path of electric waves, become radio-active, they will ionise the gas between them at once, causing a reduction of their resistance; they will simultaneously set up a statical charge, polarised at each end of each filing, causing attraction, better contact, and a further reduction of resistance. This will explain two well-known phenomena:—

1. That after the cessation of waves, the filings partly decohere, owing to the cessation of ionisation.

2. Mechanically they are further decohered by tapping, to break down the actual contact.

I have found from actual experiment that if a vacuum tube with a spark gap in series, set just to a limit across which the spark will not pass, is used as a coherer, the spark will pass on the impact of electrical waves, and continue after the waves have ceased until the current through the tube is cut off, showing ionisation of the gas in the tube, and, consequently, decreased resistance.

**O. D. L.**

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### The Measurement of High Temperatures.

I was pleased to see the reply to my letter from Mr. Weiss, and thank him for the information contained therein. I do not think he quite appreciates my difficulties. I, like him, have no trouble with short pyrometers, a number of which I have in use constantly. But my trouble is with the lengths of from 5 to 6 ft., where the temperature is to be measured inside steel annealing ovens and in the centre of the work. A clay or porcelain tube would be much too long to stand without breaking, and the pyrometer has to be taken out at each discharge of the oven, so it has a lot of handling.

I see Mr. Weiss finds his platinum wires become brittle after use. I have tried passing a current through them and heating them to a white-hot heat in the air a number of times by connecting them to a 120-volt supply with water resistance to regulate the current. By switching on and off the current about 20 times, I find it takes most of the brittleness from the wire, which should be well cleaned before putting it back.

The most brittle part of the wire appears to have the least resistance, as it takes much more current to heat it than new wire does. Can anyone explain the reason of this?

I have made an attachment to a Roberts-Austen's recording pyrometer, a short description of which may be of use to others. It consists of a fibre disc, about 3 in. diameter, with 61 brass segments equally spaced round the periphery. They are made like the teeth of a saw, so that a spring pressing on the edge slips from one to the other with a very short break of contact. The segments are divided in sections of five circuits each, and wired up to five slip rings like an alternator collector. This is driven from the centre spindle of an American clock. I am thus able to take continuous records of five different places at once. The one extra contact is left void, and so at each hour registers the zero of the instrument, and at the same time divides it up into hours. One contact next to the zero has a small resistance in circuit, and so causes a slot to drop out from one curve, and so distinguishes it and gives a point through which the hour lines on the record may be ruled. The other curves can be located by measuring from this dot. This apparatus I have found greatly enhances the value of a recording pyrometer.

If, after the ends of a couple are twisted together, they are fused on the ends by laying the couple on a carbon plate, and drawing an arc with a carbon pencil with about 3 amperes of current, they will not need to have their ends renewed at all, as Mr. Weiss mentions. It is only due to increased resistance through the ends working loose that they require renewal, and this fusing or welding prevents that. I need hardly mention that the negative pole must be connected to the pencil to produce the arc.

Like your correspondent, I have tried to do away with water jackets, and have only been successful where the terminal box is in an exposed position in the open air, otherwise the readings are unreliable, owing to thermal effects in the terminals themselves.

I do not like pivot suspension in instruments for this class of work, as it always increases the liability to error

from friction, and a strip suspension does away with one spring for control, and, besides, has no liability whatever to introduce friction of bearing.

I use an electric furnace which I made for the purpose of annealing and heating specimens of metal for recalescent cooling curves. I find it is satisfactory, and it may suit Mr. Weiss.

A porcelain furnace tube 1½ in. diameter and 24 in. long is wound with platinum wire for about a foot in the centre. The wire is ·018 in. diameter, rolled into a ribbon $\frac{3}{32}$ in. wide, and the spirals are ¼ in. apart. It takes about 20 ft. of the wire. The ends should be doubled back to carry the current without undue heating from the terminals to the first convolution on the tube. The whole is then wound with asbestos to 3 in., and is put into an iron box 6 in. diameter and packed round with broken firebrick. I am able to switch this across 120 volts and get it up to 1,300° C. in 15 to 20 minutes with a current of 6 to 7 amperes. Great care must be taken at first to get the heat up very gradually, or the tube will crack.

If this furnace is used to make rising curves, it will be necessary to take extraordinary precautions to insulate the instrument from earth, as the porcelain tube is, when at this heat, a very poor non-conductor, and the current travels along the pyrometer wires and through the instrument, and is likely to upset the reading.

I have designed for my own use an apparatus for moving the photographic plate for taking recalescent curves at variable speed, which works without friction. I do not know of any apparatus equal to it, as they nearly all have some friction in connection with the motion that is liable occasionally to produce a kink in the curve where there should not be one. I will send sketches if of any use to your readers.

**Henry J. Robinson.**

Handsworth, Birmingham.

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### Municipal Loans.

I have read with great interest the letters *re* the above in your valuable journal.

With regard to the matter of depreciation and sinking fund of municipal electricity undertakings, it appears that it is necessary at the end of, say, 25 or 30 years, to be able to completely renew the plant; in other words, at the expiration of this period, money should be forthcoming for this purpose.

May I ask you if the Local Government Board will grant a loan for the complete renewal of the plant, provided the whole of the capital, out of which this plant in question has been paid for, has been completely paid off by the sinking fund?

If the above *is* the case, I take it that the sinking fund has done its work, in making it possible at the end of, say, 25 or 30 years, to completely renew the plant by raising a fresh loan.

If this is so, may I ask what need is there for a depreciation fund? as I understand the whole and only object of such a fund is to renew the plant when worn out.

**David Smith.**

London, S.W., *April 9th*, 1903.

[There would be no reason for refusing a loan to replace plant paid for under the operation of the sinking fund; but the position suggested could never arise, as the renewals would not take place at the end of the 25 or 30 years, but at various periods, according to the nature of the plant. Accumulators, for example, have an estimated life of only 10 years.

Moreover, how can a sound business be built up on the basis of a fresh start, with fresh capital, every 25 or 30 years? Mr. Smith evidently agrees with us that under the operation of the sinking fund nothing is provided for beyond original cost, the fallacy against which we have contended being that a valuable asset remains when the loans for the plant have been paid off.—Eds. Elec. Rev.]

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### Experiments with a High-Pressure Fuse.

Referring to the article on the above in your issue of the 10th inst., I note that Messrs. Ferranti's expert, Dr. Garrard, asserts that the opinions of myself and others regarding the *reliability* of fuses used on circuits of the order of 10,000 volts (with large amounts of power behind them) are erroneous; in support of this statement, an experiment is described, the results of which are stated to prove it conclusively.

In view of this, it may be pointed out to those not well acquainted with such matters, that Dr. Garrard's tests prove nothing one way or the other; not only were the conditions (under which the Ferranti fuse in question was tested) abnormal, but they do not represent even approximately certain severe conditions under which high-pressure circuits may have to be opened in actual practice.

The fuse (a new one) was tested by placing it across the terminals of an excited alternator as a short circuit, and was, therefore, blown by a current of low power factor, and of approximately three times the value of the normal full-load current of the machine. For reasons sufficiently obvious, such a test by no means complies with the stringent requirements of modern practice, and is, as a matter of fact, by no means a severe one.

The right way to test a high-pressure fuse is to throw two machines into parallel through it, at normal pressure, *when they are in opposition of phase;* this is one of the severest conditions actually met with in practice which can be readily repeated for the purpose of testing fuses, although, of course, it is somewhat severe treatment for the plants paralleled in this way. An even better test of the capabilities of a fuse is to parallel through it a large synchronous motor at the end of a long cable line when the motor and supply E.M.F. waves are in opposition of phase.

Both these conditions are, unfortunately, sometimes met with in practice. As a matter of fact, there are occasionally a number of others quite as severe, which I need not refer to now. And when Dr. Garrard has succeeded in meeting such conditions in a satisfactory manner—not with a newly fused box, but with a fuse which has had current through it for some months (another point of some importance in practice)—I think it will be time enough for those engineers who have been through the different stages of fuse construction, and who do not believe in the reliability of fuses *under all conditions*, to modify their opinions.

**A. C. Eborall.**

London, S.W., *April 15th*.

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### Mr. Justice Buckley and Company Directors.

If the judgment delivered in the case of the Telescriptor Syndicate be taken as a criterion in the ethics of syndicate direction, then no one with any reputation to lose can safely become a director of a syndicate or company formed under the Companies' Acts 1862—1900 (particularly 1900) to investigate the merits of an invention by demonstration on a practical scale.

Whatever may have been the motive underlying this judgment, it can hardly be thought that Mr. Justice Buckley really intended to convey that the acceptance by a director of shares *which had not been paid for in cash by somebody*, constituted in itself a wrong and discreditable act. This view seems to be borne out on a closer examination of Mr. Justice Buckley's utterances.

Although he commits himself to the apparently unequivocal statement that "in accepting the gift from Wallace of the 2,000 shares, each of these gentlemen (the directors) did an act which the Court cannot approve;" he says in an earlier part of his judgment: "As to the circumstances under which the three directors, Hopkinson, Lawrence and Fisher, obtained these bonus shares from Wallace, the facts are not at present sufficiently proved," and again, "Upon the present materials the facts are not sufficiently ascertained as to whether the 2,000 bonus shares in the present company were given to these three directors in connection with their joining the board;" and again, ". . . . I have purposely abstained from referring to the question of fact, at present undetermined, whether the shares were, or not, given as a present on joining the board; for the time being I assume that question in favour of the directors." Further, it may be competent to quote the following sentence from the opening paragraphs in the judgment:—"The question I have to determine must turn upon legal considerations."

The fact that the directors of the Telescriptor Syndicate *did* accept fully-paid vendors' shares from the promoter (Barrister Wallace) seems to have been seized by the learned judge as an opportunity of pointing a moral, without, however, we fear, adorning a tale. He appears to have been horrified that acts should have been done which resulted practically in enabling someone to obtain his shares at a discount. The figures are as follows:—A director took up and paid for 1,000 shares of £1 each in a private syndicate and received 2,000 fully-paid shares from the vendor, who was also a director. This amounted to letting the director have a £1 share for 6s. 8d. Now, as the syndicate partook of the nature of a private partnership and no appeal was made to the public to subscribe for shares, why should a director *not* get his shares for 6s. 8d., or, for the matter of that, for the odd 8d. if it were considered a suitable consideration in the circumstances?

This distribution of fully-paid shares among the directors appears to have been merely a method of apportioning interests among the partners in the undertaking, one of whom contributed the invention and the remainder the cash to develop it.

When we consider the many ways in which the same result could have been achieved by the aid of the Companies' Acts and a little imagination, Mr. Justice Buckley's denunciation thereof seems somewhat pedantic.

Suppose we tell the story in the following way:—An inventor, A, brings his invention to a promoter, B, and asks for financial aid in developing the same. B naturally says, "If I do this you must give me an interest in your invention, and I shall, no doubt, have to part with a portion of that interest to those whom I may interest financially in the matter." In other words, a partnership is formed between A, B, and the financiers, C, D and E.

In order to protect themselves, and with a view to simplify the apportionment of the interest each one is to have, a syndicate is formed under the Companies' Acts, and a certain number of shares issued as fully paid to the vendor, who then transfers a sufficient number of his shares to B, C, D and E, to define the agreed interest each was to have in the business. C, D and E find money for working capital and give their time and influence without remuneration. In other words, for the amount of their contribution to the working capital fund they buy such and such a percentage interest in the invention.

This is perfectly legitimate, and to say that it amounts to obtaining shares at a discount may be technically correct from a legal standpoint, but to go further and seek to cast odium upon a man who has done this to the extent of causing him to resign his position as a Minister of the Government, is a cruel and unjustifiable act. Mr. Hayes Fisher, for whom—if he will permit us to say so—we have the most profound sympathy, can only be considered in the light of a victim of circumstances; first of all, as regards technical detail in the manner in which his agreed interest in the invention was defined; secondly, owing to a very pedantic interpretation of facts which "must turn upon legal considerations."

Mr. Justice Buckley seeks to mitigate the effect of his previous strictures in the following words at the conclusion of his judgment:—"The outcome of the whole matter is that they are heavy losers by the company. If no one else had ever been admitted to membership (which, unfortunately, is not the case), they would have been in a position to say that, if the bonus shares transaction was illegitimate, it affected, at any rate, only the creditors (for whom they would provide) and themselves," but we cannot see that the inclusion of others by transfer *one year* after the formation of the syndicate is so heinous an offence as is suggested in the judgment.

Either Mr. Hayes Fisher has been guilty of a dishonourable act or he has not. Now, no one connected with the syndicate, either as creditors or as shareholders, is one penny the worse. This is admitted. Then why has the resignation of Mr. Hayes Fisher been accepted?

**Sympathisers.**

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**Birkdale Tramways.**—The contract has been let to Messrs. Griffiths & Co., of London, for the construction of the extension to Smedley Hydro.

## ELECTRICAL FIRE HAZARDS FROM THE AMERICAN STANDPOINT.

From a paper read recently before the Engineers' Club of Philadelphia, we gather that the fire risks from electrical work are greater in the States than here, judging by the number of electrical fires recorded.

The causes are summarised thus:—

1. Short circuits.
2. Leaks.
3. Overheating of conductors, that is, current-carrying parts.

Experience shows that, generally speaking, the protecting devices, such as fuses or circuit breakers, open the circuit after the damage has been done.

Several instances of damage due to short circuits are given. One, in a lighting station, was due to an arc starting at the bottom of an alternating current switchboard, simultaneously with a "short" at an alternator. The heat due to the arc was such that the machine could not be disconnected from the board, with the result that the other alternators short-circuited and were all burnt out.

In another case, a chain hanging from a travelling crane came in contact with the live terminal of a tramway generator. Molten metal falling caused a disastrous fire.

As regards leakage, dampness may cause a leak, which, whilst being so small as not to affect the cut-out, chars the wood casing, which eventually ignites. Electrolysis, resulting in so-called verdigris, renders switch bases, &c., conducting, and causes short circuits; acting on the conductors it reduces their sections until they overheat.

Another source of danger is the electrical ignition of gas, and a case is cited in which a flexible hung over a gas bracket came into metallic contact with it, arc-ed across, punctured the pipe, ignited the gas and caused a fire.

Many other possible sources of fire are given, but as these are sufficiently obvious, it is not necessary to repeat them. One sentence, however, is too good to omit, so we quote it verbatim:—

"It has been contended that electric light stations burn more rapidly than buildings of the same construction, but used for other purposes, and it has been supposed by some that this is due to the saturation of the walls, floor, and its entire structure with electricity. The atmosphere in central stations supplying light and power is impregnated with ozone, the result of electrostatic discharges from belts and sparking brushes, and intensified by the more favourable conditions of heat and dryness necessary to the proper operation of a station. That ozone adds to the heat and rapidity of a fire once started is evident, and is a subject for further investigation."

The conditions named are purely American, as the flapping of belts and the sparking of brushes are entirely absent from modern central stations in this country. But what a lot of ozone our station engineers are missing!

The regulations in force in America—"The National Electric Code"—were compiled by the American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway Association, Factory Mutual Fire Insurance Companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light Association, and the Underwriters' National Electrical Association, and it might surely be surmised that the combined wisdom of these honourable and learned bodies would be sufficient to evolve a set of rules to meet every conceivable condition.

But, according to the author of the paper referred to, there are circumstances where, "from a possible misinterpretation, or the unusual conditions present, the code does not seem to apply." Not a very hopeful outlook for our own Institution's New Rules! We are in agreement with the author when he says the only precaution against poor joints lies in the prevention of them. Until there is some system of registration of wiremen, similar to that in vogue for plumbers, so long will the poor joint be with us, whilst jointing is permitted at all.

In the course of discussion, it transpired that in Philadelphia, where there are 16,000 wired buildings insured, the numbers of electric fires during the past few years were

as follows :—1896, 55 ; 1897, 50 ; 1898, 46 ; 1899, 76 (13 due to trolley wires) ; 1901, 89 (34 due to trolley wires).

Neglecting the trolley wire cases, the average number—about 55—has remained stationary, although the number of wired buildings must have greatly increased. It appears, also, that the insurance companies inspect the work during construction. This is not the case in this country, at any rate, not as a general rule. In the Liverpool district, the tariff offices employ a competent expert, who inspects important installations, but we are not aware that this is the case in the London district ; in fact, from what we can learn, the insurance companies will shortly accept an electrical installation just as they do a gas piping system, without question.

Whether this will tend to increase the number of fires or not remains to be seen.

## BUSINESS NOTES.

### Electrical Wares Exported.

| Week ending April 8th, 1902. | | Week ending April 7th, 1903. | |
|---|---|---|---|
| Aarhuus. Teleg. cable .. Value | £250 | Adelaide .. .. .. Value | £793 |
| Alexandria .. .. .. .. | 77 | Amsterdam .. .. .. .. | 95 |
| Amsterdam .. .. .. .. | 336 | Bombay .. .. .. .. | 183 |
| Bangkok .. .. .. .. | 131 | ,, Teleg. mat. .. .. | 56 |
| Buenos Ayres. Teleph. cable.. | 660 | Buenos Ayres .. .. .. | 74 |
| Calcutta .. .. .. .. | 1,846 | ,, Teleg. mat. .. | 250 |
| Cape Town .. .. .. .. | 667 | Calcutta .. .. .. .. | 400 |
| ,, Teleg. apprts. .. | 55 | ,, Teleg. mat. .. .. | 50 |
| Channel Islands .. .. .. | 788 | Cape Town .. .. .. .. | 416 |
| Colombo .. .. .. .. | 311 | ,, Teleg. mat. .. | 1,478 |
| Copenhagen. Teleg. wire .. | 150 | Colombo .. .. .. .. | 135 |
| Durban .. .. .. .. | 502 | Durban .. .. .. .. | 2,089 |
| ,, Teleg. mat. .. .. | 653 | ,, Teleg. mat. .. .. | 669 |
| ,, Teleph. wire .. .. | 465 | East London .. .. .. | 395 |
| East London .. .. .. | 1,387 | Gibraltar .. .. .. .. | 95 |
| Fremantle .. .. .. .. | 42 | Hamburg .. .. .. .. | 10 |
| Hamburg .. .. .. .. | 52 | Hong Kong .. .. .. .. | 346 |
| Madras .. .. .. .. | 190 | Liban .. .. .. .. | 17 |
| Malaga .. .. .. .. | 53 | Madras. Teleg. mat. .. .. | 112 |
| Melbourne .. .. .. .. | 185 | Malta .. .. .. .. | 20 |
| Pasages .. .. .. .. | 338 | Melbourne .. .. .. .. | 1,305 |
| Perth .. .. .. .. .. | 620 | Mozambique. Teleg. mat. .. | 190 |
| Piraeus .. .. .. .. | 77 | Ostend .. .. .. .. | 60 |
| Port Elizabeth .. .. .. | 249 | Penang .. .. .. .. | 38 |
| Sydney .. .. .. .. | 2,534 | Perth .. .. .. .. | 185 |
| | | Port Elizabeth .. .. .. | 362 |
| | | Rotterdam. Teleg. mat. .. | 18 |
| | | St. Petersburg .. .. .. | 16 |
| | | Smyrna .. .. .. .. | 32 |
| | | Stockholm. Teleg. mat. .. | 103 |
| | | Sydney .. .. .. .. | 669 |
| | | Syra. Teleg. mat. .. .. | 114 |
| | | Wellington .. .. .. .. | 576 |
| | | ,, Teleg. mat. .. | 214 |
| Total .. | £12,613 | Total .. | £12,060 |

### Foreign Goods Transhipped.

| | | | |
|---|---|---|---|
| Calcutta. Elec. appts. .. Value | £43 | Rio Janeiro. 49 tons teleg. wire .. .. .. Value | £— |
| Gothenburg. Elec. apprts. .. | 45 | Shanghai. Elec. mat. .. .. | 98 |
| Total .. .. | £88 | Total .. .. | £98 |

### Electrical Wares Exported.

| Week ending April 15th, 1902. | | Week ending April 15th, 1903. | |
|---|---|---|---|
| Adelaide .. .. .. Value | £263 | Adelaide .. .. .. Value | £17 |
| Aden. Teleg. instruments .. | 150 | Buenos Ayres. Teleph. cable.. | 125 |
| Amsterdam .. .. .. .. | 45 | Calcutta .. .. .. .. | 492 |
| Auckland .. .. .. .. | 3,193 | Cape Town .. .. .. .. | 101 |
| Bombay .. .. .. .. | 258 | Colombo .. .. .. .. | 128 |
| ,, Teleg. mat. .. .. | 67 | Durban .. .. .. .. | 66 |
| ,, Teleg. instruments .. | 111 | Hong Kong .. .. .. .. | 17 |
| Calcutta .. .. .. .. | 1,821 | Karachi .. .. .. .. | 40 |
| Cape Town .. .. .. .. | 418 | Melbourne .. .. .. .. | 497 |
| Channel Islands .. .. .. | 163 | Perth .. .. .. .. | 93 |
| Colombo .. .. .. .. | 52 | Port Elizabeth .. .. .. | 24 |
| Durban .. .. .. .. | 967 | Rotterdam. Teleg. wire .. | 85 |
| Fremantle .. .. .. .. | 1,801 | St. Petersburg. Teleg. wire .. | 2,494 |
| Ghent .. .. .. .. | 108 | Singapore .. .. .. .. | 22 |
| Gibraltar .. .. .. .. | 159 | Sydney .. .. .. .. | 722 |
| Hamburg .. .. .. .. | 40 | Wellington .. .. .. .. | 71 |
| ,, Teleg. mat. .. .. | 300 | Yokohama .. .. .. .. | 788 |
| Hobart .. .. .. .. | 122 | | |
| Hong Kong .. .. .. .. | 22 | | |
| Liban .. .. .. .. | 310 | | |
| Melbourne .. .. .. .. | 730 | | |
| Nagasaki .. .. .. .. | 120 | | |
| Perth .. .. .. .. | 165 | | |
| Port Elizabeth .. .. .. | 1,054 | | |
| Port Said .. .. .. .. | 47 | | |
| Rotterdam. Teleg. mat. .. | 250 | | |
| St. Petersburg .. .. .. | 60 | | |
| ,, Teleg. mat. .. | 500 | | |
| Shanghai .. .. .. .. | 346 | | |
| Singapore .. .. .. .. | 121 | | |
| Stockholm. Teleg. wire .. | 793 | | |
| Sydney .. .. .. .. | 1,248 | | |
| Tokio. Teleph. cable .. .. | 969 | | |
| Wellington .. .. .. .. | 1,146 | | |
| Yokohama .. .. .. .. | 2,882 | | |
| Total .. | £20,308 | Total .. | £5,781 |

### Foreign Goods Transhipped.

| | | | |
|---|---|---|---|
| Bremen. Elec. appar. | Value £103 | | |
| Paris. Elec. goods .. .. | 160 | | |
| Total .. .. | £263 | | |

**Music Hall Installation.**—The opening of the Chelsea Palace of Varieties during Easter has added another to the list of places of entertainment possessing an up-to-date electrical installation. The energy is supplied by the London Electric Supply Corporation at 100 volts alternating, and the Chelsea Co. at 200 volts direct, each company having approximately half the lights, and the two installations being distinct and well separated from each other, the distributing boards being 6 ft. apart.

*Stage Switchboard.*—There are two 30-kw. high-tension transformers in special fireproof transformer houses, with two separate mains supplying the stage switchboard on the London side. There is also a special main from the Chelsea Co. to supply the portion of the switchboard on their circuit. The switchboard consists of marble panels, supported on a substantial concrete platform 10 ft. above the stage. The whole of the connections are made on the front. In addition, access to the switchboard may be obtained from the back, the switchboard being 7 ft. away from the wall. The arrangements for dimming the lights are effected by means of liquid resistances, the cones being lifted by an arrangement of pulleys and tracker wires worked from the front of the board by means of 16-in. wheels, with suitable locking gear for operating any dimmer independently, or working the whole line simultaneously by means of the master lever. The dimmers stand behind the switchboard on the platform and are mounted separately on trays with mushroom oil insulators, the whole standing on a lead safe with drain in case of a jar containing the liquid being broken.

The arrangement of the cables on the board has been carefully considered, the cables of the two companies being separated, and to effect this there is provided an arrangement of iron ladders, the rungs being covered by porcelain tubes on which the cables rest. In addition to this, the pipes of each company are painted a distinct colour, and the panels of the board are labelled according to the company which supplies the panel. The stage plugs of the companies are also of different patterns. The stage lighting consists of an equivalent of 1,600 8-c.p. lamps, in addition to four projectors and 60 amperes for a cinematograph.

The auditorium and shelter lighting consists of an equivalent of 1,000 8-c.p. lamps and eight 10-ampere lamps are on the front. The whole of the wiring is in steel tube, and efficiently earthed ; and the complete installation was carried out by Messrs. Leo Sunderland & Co., 39, Victoria Street, Westminster, S.W.

**Forthcoming Book.**—Messrs. Blackie & Son, Ltd., announce for immediate publication a work entitled "Electrical Measuring Instruments," by Mr. Aspinall Parr, Principal of the Electrical Engineering College, Leeds, and author of "Parr's Direct Reading Instruments." In a preliminary chapter Mr. Parr discusses the kind of work for which each of the several types of instrument in use is best suited, and points out the advantages and limitations attaching to the use of each. The various instruments are grouped according to their working principles and, by means of diagrams, these principles explained. The book is illustrated by nearly 400 diagrams.

**Willans Engines.**—Messrs. Willans & Robinson, Ltd., have received an order from the Army and Navy Co-operative Stores for a 120-h.p. engine for direct coupling to a two-pole Crompton dynamo. The Army and Navy Stores are also installing another Niclausse boiler. An order for a Willans engine of 180 h.p. for direct coupling to a Peebles dynamo has been placed by Messrs. Fulton & Sons, of Paisley. The Warrington Corporation has recently placed a contract for a 1,250-h.p. engine with Messrs. Willans & Robinson, Ltd., the order for the multipolar dynamo for direct coupling to this engine going to Messrs. Siemens Bros. and Co., Ltd.

**The Americanised Chloride.**—At its recent meeting the Electric Storage Battery Co., of America, ratified the purchase of the Chloride Electric Storage Battery Co., of England. The *Wall Street Journal* for March 18th says that the control of the latter company was obtained through the acquisition last October of 44,000 shares for about $298,000 cash. A new board of directors has been elected, a majority of whom represent the American Storage Battery Co. Last November several experts were sent over "to Americanise the English works at Manchester," and this work is now under way. It is also proposed, says our contemporary, to reorganise the business department of the works. The Chloride Co. had already worked up a market in the British Colonies, but it is said to be the purpose of the American management "to reach out on a large scale for new business in Mexico and South America, pushing the business side from Philadelphia, but shipping the Manchester product, which can go considerably cheaper to those points than the batteries manufactured in Philadelphia."

**Electrical Garage.**—A large garage for electrical motor-cars is being opened at 6 & 7, Halkin Street, Grosvenor Square, W., by the Carl Oppermann Electric Carriage Co., Ltd. It will have accommodation for about 200 cars, with every facility for charging the batteries of electrical vehicles.

**Imports of Foreign Electrical Machinery and Apparatus.**—The value of the foreign electrical machinery into this country during the past month amounted to only £56,470 as against £65,664 in February last. On the other hand, imports of electrical goods and apparatus show an increase from £47,158 in March, 1902, to £67,999 last month. For the three months ending with March, British imports of foreign electrical machinery have amounted to £184,271, and of electrical goods and apparatus to £171,034.

**The Siemens-Schuckert Works Co.**—We have received a printed circular dated April 1st from the Siemens & Halske Co., of Berlin, officially announcing that the Siemens-Schuckert Works had commenced business on that day, and that the heavy current branches hitherto carried on by the former have now been transferred to the new company. At the same time, the technical offices of the S. & H. Co. enter the service of the new company, whose address is Askanischer Platz 3, Berlin, S.W., and at Nuremberg. Accompanying the communication is a second circular of the same date from the Siemens-Schuckert Werke, intimating the starting of business, and giving a list of the names and *fac-simile* signatures of the directors and managers of the company.

**Dissolutions and Liquidations.**—Messrs. Donnison, Berly i, Sillem & Co., electric light engineers and contractors, of Great Portland Street, London, have dissolved partnership. Messrs. Donnison & Sillem will continue the business under the old style.

First meetings of creditors and contributories of the Telescriptor Syndicate are to be held at Carey Street, London, on April 28th.

Messrs. G. Weston, S. L. Durell and E. A. Durell (G. Weston and Co., electrical engineers, 58, Fenchurch Street, E.C.) have dissolved partnership. The Messrs. Durell will attend to debts.

First meetings of creditors and contributories of the Warrington and District E L and P. Co. are to be held at Manchester on April 22nd.

Messrs. G. W. Carpenter and T. F. Mayfield, electrical engineers and contractors (Carpenter & Mayfield, Burton-on-Trent and Ilkeston), have dissolved partnership. Mr. Mayfield will continue the business under the old style.

**E.C.C. Assessment.**—At Staffordshire Quarter Sessions, the Electric Construction Co., of Cannock, appealed against the assessment of their works, and the gross assessment was reduced to £5,175, and the rateable value to £3,450.

**Books Received.**—"The Cost of Municipal Trading," by D. H. Davies. Reprint of a paper and discussion before the Society of Arts in January. The pamphlet is published by the Industrial Freedom League, of 53, Parliament Street, S.W., at 6d. per copy.

"Das Elektrische Licht und die Elektrische Heizung," by Dr Alfred Ritter v. Urbanitzky; Wien und Leipzig: A. Hartleben's Verlag.

"Pratique des Essais des Machines Electriques a Courant Continu et Alternatif," by E. Dieuaide and U. Rouvière. Paris: Librairie Polytechnique Ch. Beranger.

**Catalogues and Lists.**—From Messrs. Reiss & Martin, of Berlin, we have received a copy of their new English catalogue (45 pages) of presses, shears and special sheet metal-working machinery. In most cases prices are stated.

An illustrated bulletin (No. 6) has been issued by Messrs. E. P. Allam & Co, of Hatton Garden, giving particulars of their Premier ironclad starting switches, cut-outs, and circuit breakers.

Messrs. W. C. Martin & Co., of Glasgow, have sent us a pamphlet giving a list and illustrations of a few of the steamers which they have recently fitted with electrical installations.

A neat little eight-page pamphlet has been brought out by the Linolite Co., of Victoria Street, S.W., describing their patent system of electrical illumination to which we have already referred on several occasions. The system is fully explained and shown and some prices are given.

A small leaflet relating to the "Syro" switch (tumbler pattern) has been issued by the Syro Switch Co, Ltd., of Cazenove Road, Stoke Newington, London.

Some supplementary sheets have been received from Messrs. Monte Callow & Co, of Ludgate Broadway, E.C., for adding in with their collection already in the hands of the trade. Some new types of "Perfecta" resistance apparatus for starting and regulation, are detailed.

**Trade Announcements.**—Mr. Ernest M. Parsons, of 10, Paragon Street, Hull, has taken over the electrical department of Mr. S P. Wood, and will carry it on as a separate business at 67, King Edward Street, Hull. Mr. Parsons had had the management of the electrical department in his hands for many years past.

Owing to the death of Mr. W. Harry Stanger, the business of an inspecting, testing and consulting engineer, carried on at 2, Broadway, Westminster, is now in the hands of his son, Mr. R. H. Harry Stanger. The assistance of Mr. Geo. B. Oughterson, M.I.M.E., &c., will be continued in the firm, and there will be no change in the staff. The partnership of Stanger & Blount, chemists and analysts, ceased on the death of Mr. Stanger, but Mr. S. Dickson, who has been chief assistant in the laboratories for the past 16 years, will be manager of this department. Both branches of the business will be continued under the name of Mr. R. H. Harry Stanger.

Mr. G. Weston asks us to notify that, having retired from the late firm of G. Weston & Co, electricians, he is now carrying on the business of electric lighting and telephone contractor, under the style of G. Weston & Sons, at 153, Fenchurch Street, London, E.C.

## ELECTRIC LIGHT AND POWER NOTES.

**Abingdon.**—The E.L. Committee has engaged Mr. Wall Wilkinson, of Westminster, to report whether an electric installation for the borough is practicable and likely to be a financial success.

**Ashford (Kent).**—The U.D.C. has decided not to oppose any application by private companies for prov. orders for electric lighting in the town.

**Aspull.**—The B. of T. has informed the U.D.C. that if it is prepared to carry out the obligations imposed by the E L. order it will defer for a limited period the revocation of the order. The Council had applied for an extension of time.

**Austria.**—Messrs. Breitfeld, Danek & Co., of Prague, have lately completed a 300-H.P. gas engine on the Delamare-Debouteville system for the works of the Bohemian Mining Co. at Konigshof. It is intended for electric lighting purposes, and will be operated by the waste gases from the blast furnaces.

**Barking.**—The U.D.C. on April 9th decided to apply for a loan of £5,130 for electric light extensions.

**Bognor.**—The B. of T. has asked the U.D.C. what steps have been taken to carry out its obligations under the E.L. order, and it has been decided to reply that the Council is negotiating with Messrs. Glenn & Co. for the leasing of the order.

**Bowness, N.B.**—An agreement between the Town Council and the National Electric Wiring Co., Ltd, London, for the supply of electricity to the burgh, terminable by the Corporation at expiry of either 10, 14, or 17 years, was to be ratified on Tuesday.

**Bristol.**—A canvass of the district having been satisfactory, the Corporation Electrical Committee has decided to extend the electric lighting mains to St. George. Between three and four miles of streets are included in the scheme.

**Burslem.**—The Committee has received the report of Mr. W. H. Trentham on the proposal to provide electric lighting by taking energy in bulk from the Potteries Electric Traction Co., Ltd., and he has been asked to give details of the £15,443, his estimate of the cost of feeders, mains, and consumers' connections.

**Caerphilly.**—At a recent meeting of the D.C. a letter was read from the B of T., stating that after fully considering the application of the Council for a prov. order, they had decided not to proceed with the same.

**Cannock.**—The U.D.C. has under consideration the working of its prov. order for electric lighting by Messrs. Whittaker and Co., Dudley.

**Chelmsford.**—The assessment of the electric light works has been increased from £310 to £640. Messrs. Crompton & Co., Ltd., electrical engineers, appealed against the assessment of their works, which had been increased as follows:—Chelmsford Works, from £225 to £700; Writtle works, from £600 to £2,190. The former has been reduced to £630 and the latter to £2,036.

**Cheltenham.**—The borough electrical engineer reported that on March 21st 658 customers, equivalent to 41,156 8 C.P. lamps, were connected to the supply, compared with 570 customers, equivalent to 35,762 8-C P lamps, so connected last year. The customers had increased by 17 per cent, and the lamp load by 15 per cent. In 1902—3 there were added about 5,400 lamps, as compared with 5,760 in 1901—2. He had estimated the cost of street lighting by electricity for the ensuing financial year as £6,605 for 390 arc and £92 5s. for 18 incandescent lamps.

**Devonport.**—Antony Parish Council has asked the T.C. to supply electricity to the parish, and the request has been referred to the electrical engineer to report upon.

**Dorking.**—The Gas Co. has informed the U.D.C. that, unless it abandons the agreement with Edmundson's Electricity Corporation for the establishment of electric light works, they will apply for an injunction to restrain the Council from carrying that or any other like contract into effect. The Council, after taking counsel's opinion on the question, has decided to defend any such action. It will be remembered that the L.G.B recently sanctioned a loan of £20,000 for E.L. purposes.

**Dover.**—The T.C. has appointed Mr. H. F. Parshall to give an expert opinion on the undertaking of the local electric lighting company, which the Corporation has decided to purchase.

**Dumfries.**—A public meeting was held on 9th inst., when Provost Glover intimated that the Council was practically unanimously in favour of considering the offers of three companies for carrying out the electrical lighting order. It was finally resolved that the Council should secure the best possible terms and submit these to another public meeting.

**Faversham.**—As the Council's prov. order for electric lighting expires on July 2nd next, it has been decided to ask the B. of T. to extend the time in which to carry out the work.

**Frome.**—The B. of T. has sanctioned the electric lighting scheme submitted by the U.D.C.

**Glasgow.**—Tenders have been received by the T.C. for providing and erecting in Waterloo Street station three three-phase induction motors with switchboards, instruments and accessories to be used for transforming the additional supply of high pressure current proposed to be taken from the tramways department. They have been remitted to the engineer for tabulation and report.

In connection with the sub contract between the T.C and Messrs. Alley & McLellan, for providing and fitting up at the Pollokshaws Road station two 200-H P. engines at a price of £1,211 the special committee recommends that as the original engines are not satisfactory to the engineer, an offer by the firm to replace

them by a 750-H.P. engine coupled to two 250-KW. dynamos at the price of £2,000 for the engine, and £1,400 for the dynamos be accepted.

Mr. Chamen and two members of the Electricity Committee have been authorised to attend the annual meeting of the Municipal Electricity Association which is to be held in Sunderland in July next.

**Gravesend.**—The Kent Electric Power Syndicate has offered to purchase the Corporation electricity works, and the matter is being considered by the Electric Committee.

**Lichfield.**—The T.C. has applied to the B. of T. for an order to extend the area of supplying electric light.

**London.**—BATTERSEA.—The E.L. Committee has decided in favour of the provision of plant for conveying coal from barges to the central station. The cost is estimated at £3,500. In view of the large demand for energy for motive power purposes in the vicinity of New Road and Corunna Road and Terrace, it was resolved to extend the feeder at an estimated cost of £570. A motion was adopted that a mains superintendent be appointed at a salary of £160 a year.

BERMONDSEY.—The B.C. recently asked the support of all the local councils for the following resolution:—"That the L.C.C. be requested to include in their next General Powers Bill a clause making it compulsory on the part of any electric light, gas, water or other company, or persons, to pay for the damage done to any road or street into which traffic has been diverted in consequence of the road in which they have been at work being too narrow to allow of the traffic passing at the same time." As a result, 15 councils supported the resolution, eight decided to take no action, and three merely acknowledged the receipt of the communication.

PADDINGTON.—At the meeting of the B.C. the Lighting Committee reported that the surveyor had prepared and submitted information upon the gas and electric lighting in the borough. The Committee recommended that the whole question of the lighting of the borough be referred to a joint committee consisting of the members of the Works Committee and the Lighting Committee.

**Lytham.**—The U.D.C. has asked Mr. Parker to estimate the cost of laying electric light cables in the whole of the district, and has applied to the B. of T. for an extension of the period in which to complete the works provided for in the E.L. order.

**Maesteg.**—The B. of T. has granted a prov. order for electric lighting to the U.D.C.

**Nairn, N.B.**—Messrs. Crompton & Co., Ltd., decline to accept the Town Council's amended agreement for the electric lighting of the burgh.

**Newport.**—The Corporation has decided to substitute 72 new arc lamps for existing gas lamps in the principal streets. In adopting this scheme it is calculated that for a net increase of expense of £22 per annum an increased illuminating power of 64,280 candles will be given.

**Newport (Isle of Wight).**—The Isle of Wight Electric Light Co. has notified the T.C. of its intention to lay electric light cables in 12 streets in the town.

**Pemberton.**—The B. of T. has sanctioned a loan of £12,700 for laying new mains for electric lighting, and meeting an excess of expenditure on work already done. The U.D.C. had applied for £47,000, but the B. of T. not being satisfied that the proposed extensive additions were necessary, refused the larger amount.

**Penzance.**—The T.C. has received six offers from private companies to lease the Corporation's E.L. Order, and Mr. Trentham is to be consulted on the advisability of "farming" the order.

**Pollokshaws.**—The T.C. has again had under consideration the proposal to light up the town with electricity produced by the water-power of the River Cart, and is ascertaining the cost incurred by several other Scottish burghs in establishing their electrical installations and the annual expense of maintaining and working the same.

**Reading.**—The T.C. has requested the Reading Electric Supply Co. to quote terms for lighting the tramway routes by electricity.

**Redditch.**—Messrs. Burstall & Monkhouse, electrical engineers, Westminster, have been selected to inspect and report upon the present condition and future prospects of the electric light undertaking, at an inclusive fee of 75 guineas.

**Somerset.**—The County Council has decided to have the electric light installed in Cotford Asylum.

**Southport.**—Out of the year's profits on the electrical undertaking it is intended to devote £2,000 to the rates and start a renewal fund.

**Tadcaster.**—The tender of the Tadcaster Electricity Co. has been accepted for lighting the town by electricity.

**Taunton.**—Five out of the six conscientious members of the E.L. Committee who recently sent in their resignations as a protest have reconsidered their decision.

**Thirsk.**—The R.D.C. has approved of plans of new works to be erected in Station Road, Thirsk, by the Northern Counties Electric Supply Co.

**Walsall.**—A L.G.B. inquiry was held on April 8th into the application of the T.C. for a loan of £24,550 for electric lighting and power purposes; it was proposed to extend the E.L. mains into the Lichfield Street and Caldmore districts, and erect a new transformer station at a cost of £10,000. The Council was also going to take over the tramways and supply power for working them. To do this the capacity of the plant at the generating station would have to be increased by 350 KW. There was no opposition.

**Whitby.**—The U.D.C. has decided to advertise for tenders for mechanical stoking plant and for induced draught plant with a view to adopting one of them. It was decided to adopt the minute of the Electric Lighting Committee recommending the Council to initiate the system of rebates for long-hour consumers, that the necessary instruments for the purpose be obtained and affixed to the services of those desiring them, and that the rate be 8d. per unit for the first hour of maximum demand, and 2d. per unit afterwards.

**Whitefield.**—The U.D.C. has approached Salford Corporation relative to the supply of electricity to the town.

**Wigan.**—The B. of T. has granted a prov. order for electric lighting to the R.D.C.

**Willesden.**—The Electricity Committee of the Willesden U.D.C. has decided (with only two dissentients) to accept an offer made by the North Metropolitan Electric Power Distribution Co. to purchase the Council's generating station and outstanding liability, and to supply it with energy in bulk.

Mr. Ruthven Murray, the Council's electrical engineer, advised that the prices offered for supplying energy were much below what the Council could reach for some years. He estimated that there would be a deficiency on the first three years' working of the Council's plant of £9,672, as against £4,893 if the company's offer were accepted.

The amended proposals of the company are as follows:—

1. To pay in cash:—(*a*) The expenditure out of current account in respect of site, £128 14s. 6d.; (*b*) the instalments and interest in respect of site already paid by the Council, £284 12s. 2d.; (*c*) the instalments and interest in respect of buildings, machinery, &c., already paid by the Council, £1,325 6s. 8d.; (*d*) a sum equal to 5 per cent. on £2,710 expended on site, £135 10s.; (*e*) a sum equal to 5 per cent. on the capital expenditure in connection with the electricity works, estimate £2,990—total £4,864 3s. 4d.

2. To take over the outstanding liabilities of the Council in connection with the before-mentioned loans of £2,581 and £59,800 for buildings, &c.

3. To guarantee the Council against the deficiency for the first three years, estimated as before-mentioned at the sum of £4,893 12s. 1d., upon the understanding that should the agreement for bulk supply be terminated at the end of the first seven years, two-thirds of the amount of any such deficiency shall be repaid to the company, or if it is terminated at the end of 14 years, that one-third of such deficiency shall be so repaid, but if it is determined later, then there shall be no repayment. It is further understood that the full amount of the deficiency in either the first, second or third years shall be paid by the company, provided the limit of the total sum of £4,894 is not exceeded.

In the discussion on the terms, it was pointed out that the price to be charged by the company (which would be on a sliding scale), would work out at 2d. per unit on the amount calculated to be sold in the first year. Taking into consideration financial charges, the Council could not generate under 4d. per unit.

In accepting the offer, the Council still retained all the advantages of its prov. order, and could at any future time generate on its own account.

**Wilmslow.**—The B. of T. has granted a prov. order for electric lighting to the Alderley and Wilmslow Electric Supply Co., Ltd., for the supply of energy within the area of the U.D.C.

## ELECTRIC TRACTION NOTES.

**Barrow.**—The laying of the electric tramways did not commence in March as had been anticipated, as the Council did not approve of the course adopted by the B.E.T. Co. in sending in only one tender for the overhead wires, pillars, cars and permanent way, that being a Brush Co.'s tender.

**Burton.**—Acting on the advice of a committee, the Council is advertising for an electrical engineer for the tramway works, who will also act as tramway manager and traffic superintendent. The electric lighting works will also come under his supervision. A salary of £300 is suggested.

**Birmingham.**—Last week the Tramways Committee again discussed the offers of the two parties anxious to obtain the tramway concessions. The Committee at the end of its deliberations handed to the Press the following official account of what transpired:—"The Tramways Committee are agreed in advising the Council that the inability of Messrs. Batten, Proffitt and Scott to acquire the outstanding leases makes it impossible that their offer should be entertained. They are also unable to advise the

acceptance of Mr. Garcke's modified offer based on an extension of the leases to 1911. After full discussion of the various proposals for leasing which have been before the Committee, some of its members who were parties to the recommendation for acceptance of Mr. Garcke's original offer are now of opinion that it should be declined. In accordance with the views of the majority of the Committee, a fresh report will therefore be issued, withdrawing the previous recommendation. As the chairman is not in accord with these views, the Committee have requested Alderman Cook, as representing the majority, to submit the report to the Council, and a direct vote will be taken upon the question." It is stated that if the report is approved, the Council will stand committed to municipalisation by virtue of the unrescinded resolution of 1899.

**Cardiff.**—At a meeting of the County Council last week Alderman Trounce said that Mr. A. Ellis, the electrical engineer, in his monthly statement of receipts and expenditure for February last, had entered £1,666 13s. 4d. as loan charges for that month. He (the speaker) contended that a sum of £2,700 at the least should have been entered. Taking the capital expenditure given for February at £540,000 at 6 per cent., it confirmed his figures, and, again, £32,733 was provided in the new estimates for 12 months, which amount was practically due and payable on December 31st next, and not on March 31st, 1904. Therefore, on this basis again, over £2,700 was payable for February, and not £1,666 13s. 4d. If the receipts for February were taken in full, so should the precise expenses be debited in full. If they charged to next year loan charges for the three months now ending, it was easy to arrive at the inaccuracy of the figures shown. As an illustration, if they were to close their business on March 31st, they should have to pay three months loan charges of about £8,000, whereas all the receipts and income would have been credited. He hoped a Government auditor would be invited to consider the accounts, and make suggestions in regard to their finances. Mr. Courtis said the £120,000 on which Alderman Trounce based his calculations, covered a period of 12 months ending March 31st, and not up to December 31st. Mr. Ellis, electrical engineer, stated that he based his calculations on figures supplied by the borough treasurer, and he had taken the proportion as being one-twelfth of the £20,000 for the whole year.

**Central London Railway.**—In reply to a question in the Commons, Mr. Gerald Balfour said that the Central London Railway Co., with the object of reducing vibration, ordered 64 motor-cars in May of last year. Several cars have already been delivered, and six motor-car trains are now in actual service, while a seventh will be added in the course of the week. The remainder of the cars will be put into service as soon as they are delivered to the company.

**Derby.**—The E.L. Committee has agreed to supply the energy required for working the tramways, to the Tramways Committee at the rate of 1¾d. per unit up to 250,000 units per annum, and at the rate of 1½d. per unit for the whole of the energy supplied when the consumption exceeds 250,000 units per annum. The Chairman of the Committee said that he would shortly place before the Council a complete statement of new plant required in carrying out this agreement. Mr. Wilmshurst, the borough electrical engineer, had no doubt whatever that they would be able to produce the energy for the price stated. As to whether it was proposed to put down the necessary machinery in the present building instead of erecting a fresh one, he said that at the present moment they had a certain amount of space in their works, and the Committee did not see any reason why that space should not be used for the purpose for which it was provided. There was plenty of space for providing the energy both for electric lighting and tramway purposes for some years. In the future they would have to take in a larger extent of land, and put up more buildings. When they had to do this, and provide the power for the electric trams, they would require something like £40,000. Mr. Newbold took it that the report virtually committed them to a combined station. Several members pleaded for more information, and in the end the report was referred back for this purpose.

**Halifax.**—The Corporation has decided to invite estimates for a car built to run on the railless principle, with accommodation for about 20 passengers, and to mount a gradient of 1 in 10. This car it is proposed to use experimentally, as it is thought that it may be suitable for some of the Halifax thoroughfares.

**Huddersfield.**—Great disappointment is felt in Huddersfield at the fact that the working of the tramway department for the financial year shows a deficit in revenue of over £12,000, being equal to 7d. in the £ on the rates. The accumulated deficit is now £21,000.

**Johnstone, N.B.**—Much irritation is felt locally at the long delay in getting a start made with the Paisley District Tramways, and the Council has decided to get some definite reply from Mr. Murphy, the promoter.

**Kilmarnock.**—It is estimated that the total cost of the proposed electric tramway scheme will amount to £59,000, while the sum of £28,000 will be required for the electric lighting scheme.

**Kirkcaldy.**—The T.C. has decided to adopt loops for certain parts of the system in place of a double track, as previously proposed.

**London.**—Camberwell.—At the Borough Council meeting on Wednesday, a letter was received from the L.C.C., asking the Council to rescind or suspend the operation of the resolutions passed by it requiring that the electrification of the tramways within the borough should be carried out strictly within the provisions of Sec. 26 and 27 of the Tramways Act, 1870. Several members complained bitterly of the way the work was being done in the Old Kent Road, and a motion was proposed that the L.C.C. be prosecuted for contravening the law. This was negatived. After a long debate, it was agreed that a settlement of the points of dispute between the L.C.C. and the Borough Council be offered on the following terms:—That on the L.C.C. deciding to construct a tramway from Camberwell Green to Lordship Lane, the Borough Council pay one third of the £34,000 estimated for the necessary street improvements and widenings; that on the L.C.C. agreeing to widen Queen's Road, on the line of the proposed electrification between New Cross and Rye Lane, the Borough Council contribute £2,200 towards the cost of such widening.

Hackney.—At the B.C. meeting last week it was reported that the North Metropolitan Tramways Co. had submitted drawings showing the proposed reconstruction of the lines at Stamford Hill northward from Amhurst Park. Electric cars would be put on, and worked on the overhead trolley system. It was resolved to raise no objection in respect to the lines within the borough.

**Manchester.**—When the Corporation decided upon a municipal system of electric tramways the settlement of terms with the lessees of the old city lines, the Manchester Carriage and Tramways Co., became a question of great importance and difficulty. The award of Sir F. Bramwell, who was called in to arbitrate, left certain legal questions undecided, and an appeal to the High Court of Justice seemed necessary. To avoid this, negotiations with a view to an amicable settlement were opened. For some time these negotiations were regarded with little hope; the company seemed too completely wedded to a view which the Corporation could not possibly accept. In fact, it was definitely announced a fortnight ago that the negotiations had been broken off. This, however, seems to have been premature, for more recently an authoritative statement has been published to the effect that, in lieu of the sum of £496,000, awarded to the Carriage and Tramways Co. under the higher of his two awards, by Sir F. Bramwell, the representatives of the Corporation and the company have agreed upon a sum of £335,000, the company to retain certain stables, horses and rolling stock.

The cross route to connect the Greenheys district of Manchester with Gorton, by way of Dickenson Road, Stanley Grove and Kirkmanshulme Lane is now completed, and it will be opened for traffic without delay.

The Manchester Corporation electric tram service has now been opened to Stretford.

**Metropolitan District Railway.**—It is stated that on 9th inst. the directors of the District Railway Co. made a trial trip in one of their new electric trains over the extension from Ealing to Harrow. "It is expected that the line will be open on May 1st."

**Mexico.**—The street tramways of Mexico, which began not many years ago as a few independent mule lines, Consul Jerome reports, have grown into an extensive electric system, which is now conducted according to the most approved methods and with the most up-to-date electrical equipment. The new arrival in Mexico City, he remarks, is likely to be struck with astonishment by the irreproachable equipment, excellent service and high speed of the electric trams on the main lines and branches, which cover the entire city and extend to the outlying suburbs and numerous points of historical and romantic interest. The lines now worked aggregate 190 miles, with a considerable mileage under construction and still more projected. The daily service is maintained by 604 cars, including motors, trailers, freight locomotives and gorgeous funeral cars. The power plant, Consul Jerome states, is one of the best in the Republic. In the engine room are four huge compact MacIntosh & Seymour compound condensing engines, two of 600 and two 1,200-H.P., coupled direct to big generators, which supply a continuous current of 3,600 H.P. The MacIntosh & Seymour engines, it is stated, have been found so satisfactory for this work, that engines of the same type and of the same make have been ordered for the new electric light plant, now building by Messrs. Anthony Gibbs & Co., of London. These engines are said to have been found to reduce the coal consumption—a considerable item in Mexico—to the closest possible margin. Besides the engines the company has in operation storage batteries of 1,500 H.P., which are charged during the hours when traffic is light, and are put into service when the conditions of travel demand additional power. The enormous and growing business done by the street railway is shown by the number of fares collected during the year 1901, which reached the grand total of 26,709,225, while in 1902, up to November 30th, the fares totalled 28,285,044; with the month of December the cash fares collected are estimated to have been more than 30,000,000 for the year. Considering that no fare is less than 6 c., and rises by gradations according to the distance travelled outside the city to 30 c., it may be seen that the income of the Mexico City Street Railway Co. is by no means small. The company employ in the offices, traffic department and workshops, and on the permanent way, &c., 2,438 persons. Reporting on the public works of Tampico, Vice-Consul Griffith states that the city is now supplied with a system of arc and incandescent lights and also with a good telephone service. It has also a system of street cars drawn by mules, but, according to the concession, electric power must be introduced at the end of two years.

(*Continued on page* 663.)

## QUEEN'S ENGINEERING WORKS, BEDFORD.

Few engineering works in this country have made more rapid strides than those of Messrs. W. H. Allen, Son & Co., Ltd., known as the Queen's Engineering Works, Bedford. The firm was established in 1894 under the title of W. H. Allen, Son & Co., and in the year 1900 it was converted into a limited company with two directors, viz, Mr. W. H. Allen and his eldest son, Mr. Richard W. Allen.

Queen's Engineering Works: Offices.

The works are situated on the western side of the main line of the Midland Railway Co., and cover four acres; six acres are available for extensions. They have been built and specially equipped with plant for the manufacture of very high-class machinery, comprising auxiliary machinery for the Admiralty, such as steam dynamos, centrifugal pumping engines, air-pumping machinery, and fan engines; small electric gear for the mercantile marine; and machinery for large central stations, comprising engines and dynamos, motors, condensing plant, and Edwards air pumps.

The works employ about 800 men, and are an example of the best modern practice. The latest methods have been adopted for the manufacture of interchangeable parts, and some of the newest types of machine tools have been put down during the last few years.

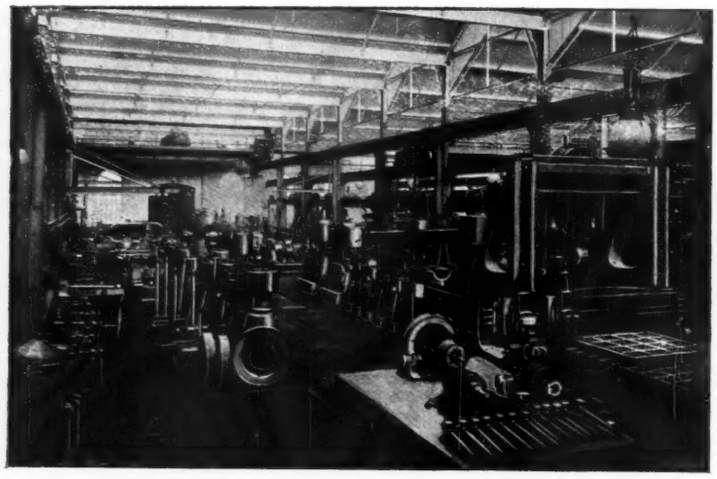
The front entrance is approached by a picturesque garden, which is somewhat unusual in this country, and adds greatly to the appearance of the offices; the latter are of an elaborate character, all on one floor. Great attention has been paid to the drawing office in order to give ample light and good ventilation, as upwards of 40 draughtsmen are employed therein.

The power station includes four boilers of the Babcock and Wilcox type, constructed for a pressure of 300 lbs., but working at 200 lbs. pressure. This, however, can be increased when it is required to carry out several tests at the same time. Two of the boilers are capable of evaporating 5,000 lbs. of water per hour and the remaining two 6,000 lbs. per hour. A separate siding has been arranged so that the coal can be brought alongside the bunkers. Messrs. Allen use what is known as the Waines-Dufferin coal exclusively, and although a very high price is paid for this special coal, they have found from experience that it is the most economical in the end.

The boilers are fitted with a special apparatus in the drums for softening the water, owing to the Bedford Town supply being of a very hard character. When the works were first started repeated trouble was experienced owing to the hardness of the water; this deposited a substance in the lower boiler tubes, which consequently became hogged, cracked, and burst; but since the addition of purifiers this has been overcome. The boilers are worked in conjunction with Messrs. Allen's induced draught system; hence a very small chimney, only 4 ft. in diameter, is required to take away the waste gases. Messrs. Weir's feed pumps are employed for feeding the boilers, and there is a large feed-water heater and detartariser of Messrs. Boby's make, the

Heavy Machine Shop.

heat for which is obtained from the waste steam from the steaming bed. The main steam pipe is taken to the testing bed as well as to the engine room, so that the steam pressure can be maintained constant, notwithstanding the great fluctuations in load, owing to the intermittent work on the steaming bed.



Part of Heavy Machine Shop.

The engine room is placed alongside the boiler house, and the driving machinery consists of three sets of generators, viz., two 160-KW. sets and one 100-KW. set. Both the engines and the generators are of the company's manufacture, the dynamos being compound wound for 250 volts.

A surface-condensing plant has been put down specially for the generating plant, with an Edwards air pump and a centrifugal circulating pump.

A Klein cooling tower is placed alongside the power house, as well as a special apparatus of Messrs. Holden & Brooke's make for separating the oil from the exhaust steam.

The company have laid down a complete testing plant, which is capable of testing engines up to 1,000 H.P. This department is divided into three branches, viz., the Admiralty testing department, central station engines and dynamos, and that for auxiliary machinery and motors.

An arrangement is made in the Admiralty testing department so that a complete generating plant for a first-class battleship or cruiser, consisting of four engines, each of 60 KW. capacity, which represent their present requirements, can be tested simultaneously.

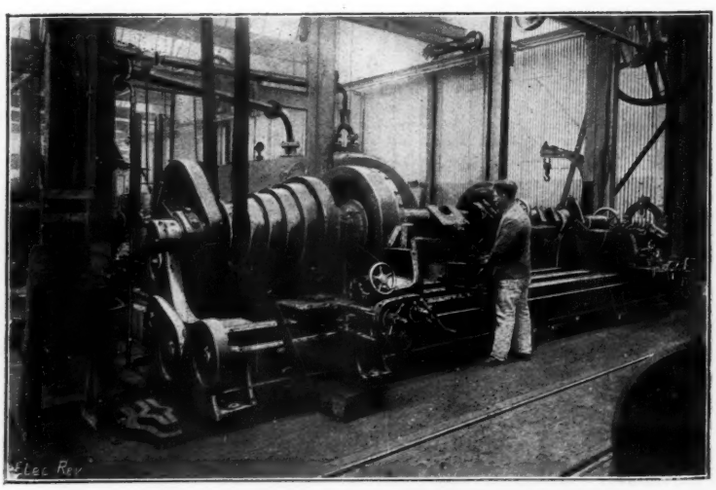
Special plant is provided for ascertaining the steam consumption of the engines. It consists of a surface condenser of 1,400 sq. ft. and two sets of Edwards air-pumps, delivering direct into two large measuring tanks. All trials hitherto have been taken with standard instruments of the Weston type, but owing to the importance attached to the steam consumption trials at engine makers' works, the company have erected a complete potentiometer of Messrs. Elliott Bros.' make, for checking the various instruments. A Craven traveller is provided over the test bay capable of lifting 10 tons, which is electrically driven by the company's standard motors.

Messrs. Allen have fitted up for testing motors a very neat arrangement. An engine and dynamo is employed having a double-wound armature with two commutators, the fly-wheel being made so as to form a pulley. The dynamo is run with the armatures either in series or parallel, or with the field coils in series or parallel, or separately excited, so that when the motor is running at its normal speed, the dynamo is giving approximately the correct pressure. The motor under test assists to drive the dynamo, and the dynamo, in turn, generates current for driving the motors, the engine merely taking up the losses. This test therefore resolves itself into a form of Hopkinson test, the advantage being in the small consumption of steam for the six hours' run, when there is only one motor of a kind to test.

The erecting shop is divided into various departments. There is a centrifugal pump section, where Admiralty and Mercantile Marine centrifugal pumps are being manufactured, and the company's type of condensers tubed. Messrs. Allen have adopted a very neat motor-driven apparatus for expanding tubes into their condensers. The company were the pioneers of the manufacture of Edwards's patent air pumps, and have made many hundreds of them.

Messrs. Allen have adopted the principle, during the last two years, of dividing into separate departments the construction of the various parts of engines; for instance, the putting-in of the crankshafts, the fitting together of the motion work, the setting of the cylinders, the fitting-up of the governors and the general assembly of the various parts. It was formerly the company's practice for one erector and a gang of men to fit a complete engine together, but by this new arrangement it has been found that an enormous saving is made not only in cost, but also in the character of the work. We give herewith illustrations showing some of the different departments.

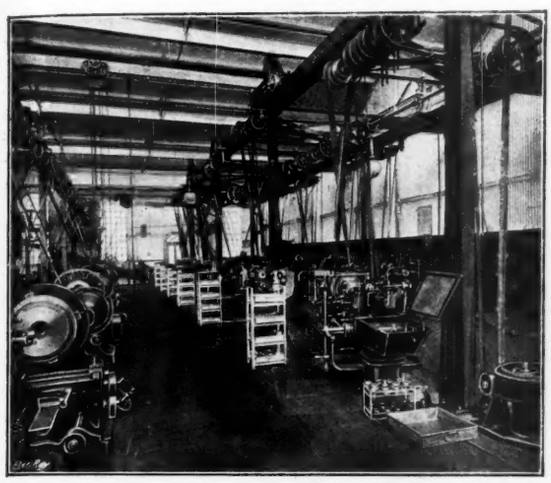
The heavy machine shop is allotted to the largest machine tools in the works, including a planing machine of Messrs. Armstrong, Whitworth & Co.'s make, which takes 8 ft. 3 in. square × 16 ft. stroke. Another planing machine by the Pond Co., of Plainfield, is a rapid moving machine, cutting cast-iron at a speed of 26 ft. per minute. Both these machines are separately electrically driven. In this bay are also Niles & Bullard boring machines, the former of 90 in., and the latter of 62 in. diameter. Two large machines by Messrs. Shanks, of Johnstone, one vertical, and the other horizontal, have been installed, the former being a planing machine, and the latter a large boring machine for engine bedplates. The crank lathes are worth special attention, the largest being by Messrs. Craven, of Manchester, of which we give a view, a very powerful machine, also electrically driven. There is further a crank lathe made by the Pond Machine Tool Co., of Plainfield,



Crankshaft Lathe.

both these tools being designed specially for turning three-throw engine crankshafts.

In the medium machine shop various groups of centre-



Semi-Automatic Machines.

crank lathes and drilling machines are to be seen. The former are mostly by Messrs. Craven, of Manchester, strong machines, all using the high-speed tool steel of Messrs. Seebohm & Dieckstahl's make, and known as their "Capital" brand, and Messrs. Armstrong-Whitworth's "A.W." steel. The use of this tool steel has made a wonderful advance towards the reduction in cost of machining, and has necessitated increasing the speed all round of the various machine tools. A very complete equipment of drilling machines is also provided, there being no less than 18 in one cluster of Messrs. Muir's manufacture.

A complete set of boring machines are grouped together of Messrs. Lang's, Bullard's, and the Gisholt Co.'s manufacture.

automatic machinery is by Messrs. Herbert. The work from these machines is placed in the oil separators before passing to the stores.

A separate department is given to the milling machines, which are made by Hulse, Lang, and Muir.

The majority of the machine tools are driven by means of friction clutches fitted direct on to the main driving shafts, thereby saving a large amount of power and belting which would otherwise be required to drive the top gear.

The limit system of gauges is used exclusively throughout the works, these gauges being manufactured by Messrs. Loewe, of Berlin. The company pay great attention to the manufacture of jigs, in order that work shall be made interchangeable. A very fine equipment of standards is provided for the use of the tool room, comprising standard screw gauges, standard cylindrical gauges and length gauges. The screw gauges which are issued to the works are checked twice a week, and the limit gauges once a week. The tool room is fitted up with the necessary machines for the manufacture of the various gauges and the up-keep of the milling cutters.

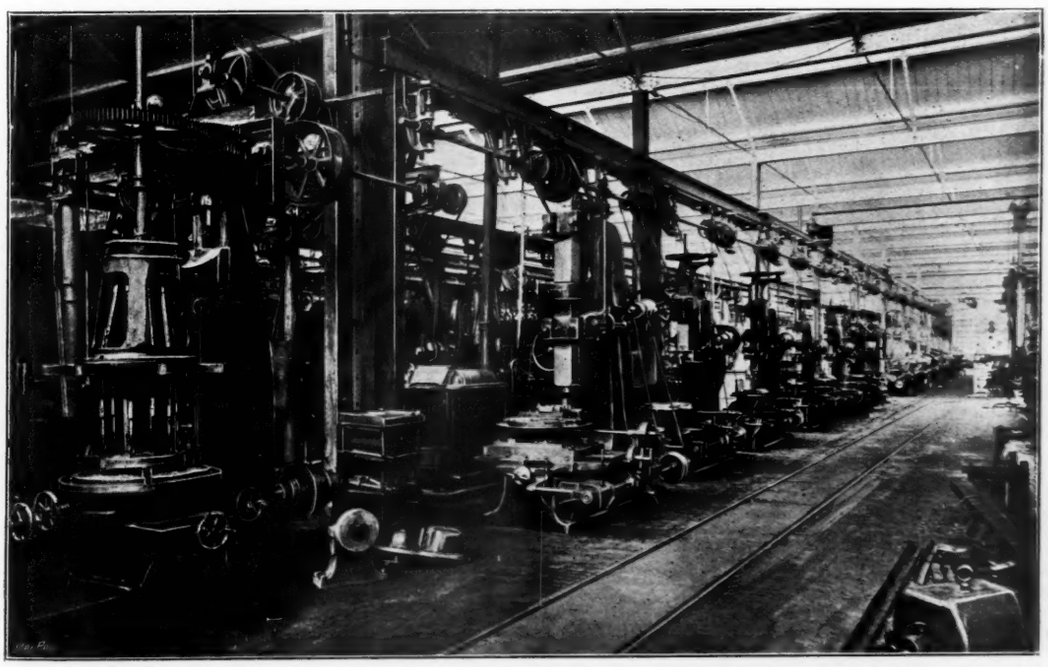
A complete system of examination is carried on throughout the works. When the various articles have left their machines, they are sent to the examination table, and thoroughly checked over before being passed. The company provide for every department an ingenious measuring apparatus, in which the measurement is clearly seen on the face of a small dial.

Running longitudinally is an extensive bay which feeds each separate department with material, and in the west end it is used for loading, the Midland Railway siding passing into this particular department.

The machine shops generally are provided with ample means of lifting apparatus, three 10-ton electric travellers and one 15-ton electric traveller being in use. The whole of the electrical equipment has been carried out by the company.

The dynamo shop is situated in the north-west corner of the main building, and in this shop may be seen a large number of continuous-current dynamos of various sizes in process of manufacture.

A prominent feature is a cylindrical vacuum chamber for



Medium Machine Shop.

A series of Jones & Lamson, Ward's, and Herbert's machines are also to be found in this bay. These are grouped in such a manner that the material is handled with the least possible expense. Bolts are turned out of the solid up to 2 in. in diameter, larger sizes being forged. The

extracting the moisture from armatures and field magnet coils without the use of high temperatures.

The armatures in almost every case are of the multipolar slotted type, with the "barrel" form of winding.

For the winding of field magnet coils, special machines,

each driven by a small motor, are in use. The wire is fed from a drum over a series of pulleys on to a bobbin, the feeding apparatus being provided with a horizontal traverse motion. The number of turns is registered by means of a counter.

A number of benches are fitted up behind the winding machines for the purpose of assembling the commutator sectors. After the plates have been subjected to a final straightening to correct any twist that may have been given to them in the drawing process, they are placed with the alternate pieces of mica in a special chuck for turning. After the turning, the commutator is mounted upon an iron sleeve cast in one piece with one of the end rings, the second end ring being tightly forced home by means of bolts passing through the inside of the commutator. Lastly, the commutator is placed in a stove and heated approximately to 400° F., when it is finally tightened up. When it is cold slots are milled in the sections at one end to receive the commutator lugs, which are then sweated in.

Testing Bed.

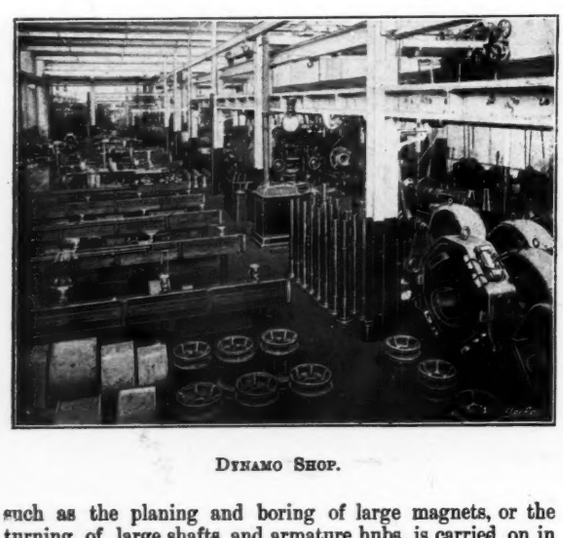
At one end of the western part of the shop are arranged three lines of shafting, each driven by a separate semi-enclosed motor. Among the machine tools thus driven are lathes for banding armatures, a horizontal machine for boring work, a Bullard vertical boring mill, chiefly used for turning commutators and end-plates for semi-enclosed motors, a heavy punching machine, and a number of small tools, which together serve to supply the smaller needs of the dynamo shop. Two Bliss notching machines for stamping slots in armature discs are in continual use. Heavier work, such as the planing and boring of large magnets, or the turning of large shafts and armature hubs, is carried on in the main machine shop. Much time is saved in taping the shaped armature coils and bars by the use of several special taping machines.

Another portion of the shop is devoted to the building of armature cores and general fitting work. Hydraulic pressure is used in every case for the purpose of forcing the armature hubs or spiders on to their shafts.

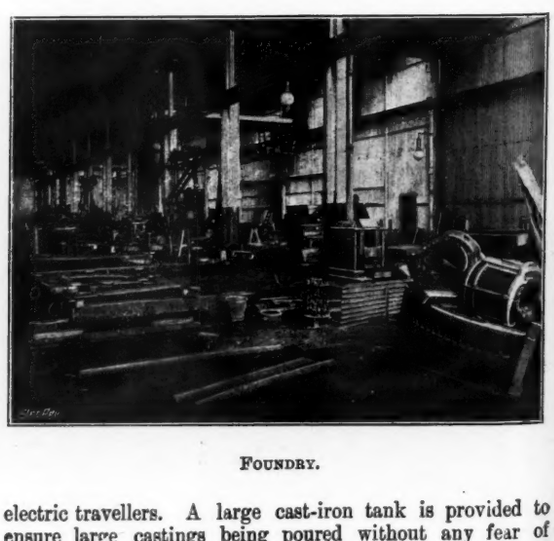
The length of the western half of the shop is traversed by an electric 5-ton travelling crane by Craven Bros., while along the eastern side are two smaller hand travelling cranes. In addition to these there is a portable workshop crane, which is found very convenient for lifting heavy work into and out of the machine tools.

Between the dynamo shop and the foundry is the present smithy, but it is now contemplated to remove this, together with the foundry, to the north end of the property, in order that the present machine shops and fitting shops may expand. The smithy is provided with three hammers of Messrs. Massey's construction, the largest one being 20 cwt. The company do most of their own forging, and the steel which is used, is exclusively of the Siemens-Martin open-hearth process, having a tensile stress of 30 to 35 tons per square inch with an elongation of 27 per cent. The smithy blowers and various other machine tools in this department are driven by an electric motor.

The iron foundry is situated in the north end of the fitting shop, and consists of two bays, 60 ft. wide × 260 ft. long. The cupolas are on the eastern side of the foundry; the large one melts 15 tons, and the small one 10 tons per hour. The blowers are of Messrs. Baker's type, driven by an electric motor. The foundry is fitted with four electric travellers, three of 5 tons and one of 15 tons. On every other column is fitted hand-lifting gear in order to assist the electric travellers. A large cast-iron tank is provided to ensure large castings being poured without any fear of dampness owing to the proximity of water to the surface of the ground. Great attention is given to the special mixtures of metal for the various castings. Messrs. Allen have their own particular mixture for their high-speed engine cylinders, which is found in practice to be most suitable.



Dynamo Shop.



Foundry.

The brass foundry consists of two bays, each 30 ft. wide, and is arranged to make the largest pump castings required for the British Admiralty, which at the present moment attain to about 30 cwt. Six pot furnaces are provided, as well as one large air furnace. The brass foundry alone turns out nearly two tons of castings per week.

The pattern shop is a large building, fitted with all the latest improvements; it is electrically driven, the lathes and wood-working machines being mostly made by Ransomes.

At the northern end of the works is situated a pond for cooling the circulating water from the condensing plant used in connection with steam trials on the testing bed. This is fitted with two large weirs.

The company have their own testing machine, which plays an important part in the business. The cast-iron, steel and gun-metal are tested daily, thus ensuring the best material being used for the various manufactures.

The company have for several years taken a great interest in the training of pupils, Mr. W. H. Allen devoting his personal attention to their progress. A department is set aside for this purpose, and a demonstrator is in constant attendance, who not only assists in solving difficult problems connected with their work, but also guides them as to the literature of allied subjects, so that they may be able to read in their spare time and attain a deeper knowledge of their business. The demonstrator superintends all the pupils in the various departments, and is entirely responsible for the work which they are engaged upon. Lectures are given in a spacious lecture room connected with the main offices every Monday evening on various subjects. The pupils are also constantly in touch with the directors, who endeavour to exercise a useful control over them and to promote the welfare generally of each pupil.

The rapid progress made by the firm since Mr. Allen established the business in 1880 (at York Street, Lambeth, London) is sufficient evidence of the high standard of merit attained by their products. The pleasant relationship existing between the company and their employés is very gratifying, and there appears to be a feeling throughout the works that everyone shall do the best he can for the company. It is on such lines as these that the best results must be sought, both for men and masters.

## ELECTRIC TRACTION NOTES.

(*Continued from page* 658.)

**Newport (Mon.).**—The new system of electrical tramways, instituted by the Corporation, was successfully opened on the 9th inst. The members of the Corporation foregathered at the Town Hall at 11 o'clock, and shortly after, two cars having been brought round from the car sheds, the Mayor (Mr. J. H. Dunn) boarded the first, and with the Corporation electrical engineer (Mr. H. Collings Bishop) as driver, took the lead. The members of the Council and a few friends accompanied on this and the following car. The first run was to the terminus on Corporation Road *vid* High Street and Clarence Place, and everything worked smoothly, and to the satisfaction of the trippers. The proceedings caused much interest in the town, and large crowds witnessed the ceremony. Returning from the Corporation Road terminus, a stop was made at the power station, where a thorough inspection was made of the buildings and plant, after which the party returned to town and proceeded to the Pillgwenlly terminus, near the Docks, where the Mayor, in a commendably brief speech, declared the system open. Councillor Phillips, in speaking to a vote of thanks to the Mayor, declared his belief that the new tramway system would greatly benefit the ratepayers. The party then returned to the Town Hall, and shortly afterwards the tramways were opened for general traffic. A luncheon had been arranged for, but owing to the death only a few days before of Alderman Henry John Davis, it was abandoned. The deceased gentleman had been the father of the Council, and a member of that body for over 60 years. During the remaining portion of the day and the following day (Good Friday), the total number of passengers carried was approximately 40,000, although as yet only two branches out of six authorised, are completed, three of the remainder being still in the hands of the contractors, and the Stow Hill branch not yet commenced. The system, when fully completed, will have a total length of nearly nine miles. It was inspected the day previous to the opening by Major Druitt, for the Board of Trade, he being accompanied by Mr. Trotter, electrical expert to the Board. After his inspection, Major Druitt expressed his approval of the manner in which the work had been carried out, Mr. Trotter's report upon the overhead equipment being also satisfactory. The system is laid down to the plans of Mr. Horace F. Parshall, who was engaged by the Council in 1898. The work of constructing the permanent way was entrusted to Messrs. A. Krauss & Son, of Bristol, who have made excellent progress with the work. The track is laid with double lines throughout, the only interlacing portion being in High Street, the narrowness of which necessitated a resort to this for a space of about 100 yards. It is expected to give a speed of 10 miles per hour maximum, with a lower rate in the more crowded portions of the town. There will be a continuous-through service, at intervals of two minutes in the centre, extending to about eight minutes at the suburbs. The cars are of a handsome double-deck pattern, by the British Westinghouse Co., and are fitted with hand and electric brakes, and Tidswell's life guards. The power is developed by two 30-H.P. motors, the return circuit being provided by the rails. The car sheds provide accommodation for 50 cars, on nine sets of rails, each set provided with pits; the repairing shop adjoining gives every facility for dealing with repairs, being fully equipped with up-to-date machinery and tools, driven by electricity. The overhead work of the system has been carried out by Messrs. W. T. Glover and Co. It is divided into several sections, independently controlled from the generating station; it is of span wire construction throughout, the height of the poles being 30 ft. The cables are the production of Messrs. Henley's Telegraph Works, Ltd., and Messrs. Callender's Cable and Construction Co. put down the ducts. The power station consists of engine house and boiler house, of steel framework surrounded by brickwork, with fireproof roofs of steel and concrete, covered with slate; the steelwork used in the construction of these being produced by Messrs. Hemingways, of Middlesbrough. The stack is 208 ft. high, with an inside diameter of 12 ft. The boiler house contains six water-tube boilers by Babcock & Wilcox, each capable of evaporating 10,000 lbs. of water per hour. An automatic stoker, by the Underfeed Stoker Co., is provided for each boiler, and a coal conveyor, with a capacity of 50 tons per hour, has been supplied by the New Conveyor Co. The economiser, which utilises the waste gases from the flues, heats the water before it is pumped into the boilers. The engine room contains two vertical compound engines of 1,000 H.P., by Messrs. Markham, of Chesterfield; these are coupled direct to two 550-KW. generators, by Messrs. Witting Bros. A third unit is about to be installed, and space remains for another unit, in addition to which provision has been made for enlarging the engine house when that becomes desirable. Condensing plant of an efficient capacity has been provided by the Worthington Pumping Engine Co., and a switchboard of a size and design commensurate with the work demanded of it is placed upon a gallery at one end of the engine house. A 25-ton crane, driven by motor power, travels the full length of the house, and is more than capable of dealing with any part of the machinery. At first, current for the tramways will be generated by one engine, another being used for the supply of current for lighting and other power purposes, the third unit being kept in reserve. A storage battery, by the Electric Power Storage Co., is provided, in connection with which is a 50-KW. three-wire lighting booster, and a Highfield traction booster. The capital expenditure to date by the Newport Corporation is returned as follows:—For tramways, £72,892; for power station, £120,438. The latter may be regarded as almost completed, but a good deal of money remains to be expended upon running contracts before the tramways are finished.

The Corporation have received a letter from Messrs. Hemingways, Ltd., with reference to their contract for structural steelwork for the Newport power station, which states that the firm consider themselves entitled to compensation for additional expense incurred in consequence of delay in obtaining possession of the site and alteration to the formation level of the power house, as shown upon the drawings given to them for the purpose of tendering for the work, on which their estimate was based, this involving them in the necessity of purchasing special extra plant, and also entailing very considerable additional expense in the labour of erection. Messrs. Hemingways state that all they wish to be repaid is the bare expenditure incurred by them on behalf of the Corporation in carrying out the work, placing the amount at £920 18*s.* 8*d.* The Electricity Committee have replied to Messrs. Hemingways that they cannot entertain the claim, and informing them that the question of the Council claiming damages from them on account of delay in completing their contract is under consideration.

The Incorporated Municipal Electrical Association have communicated to the Corporation a code of suggested rules for the police to observe in cases of overhead wires charged with electricity falling in the street. The matter has been referred to Mr. H. Collings Bishop, borough electrical engineer, to report upon.

**N.E. Railway.**—The North-Eastern Railway Co., who some time ago commenced the construction of a number of motor-cars, have recently placed a contract with the Wolseley Motor-Car Co., Adderley Park Works, Birmingham, for two large four-cylinder petrol engines. These engines, now nearing completion, have horizontal cylinders, and are designed to give no less than 95 H.P. on brake; they will be substituted for the vertical petrol engines of a different design previously ordered by the North-Eastern Railway, which, as the result of recent experimental trips, are not found altogether suitable for the traffic requirements. The cars are 53 ft. long, 13 ft. high, providing seating accommodation for 52 passengers. The vehicle is practically a tram saloon, with framework carried on two four-wheeled bogies, with engine compartment at one end and conductor's compartment at the other. The cars, electrically illuminated, and fitted with electric brakes, may be driven from either end, and, carrying 30 gallons of petrol, run for seven hours on end. The service will be shortly introduced for providing speedy and frequent train service between Hartlepool and West Hartlepool, where the competition of the electric street cars is severely felt.—*Newcastle Daily Leader.*

**Northampton.**—Edmundson's Electricity Corporation has asked the T.C. whether the Corporation is prepared to lease the tramways undertaking with a view of adopting electric traction. The Council has declined to enter into negotiations, having itself resolved to electrify the system.

**Poole.**—It has been settled that Poole (or Poole and Branksome jointly) is to purchase the undertaking of the Poole and District Electric Traction Co. and lease it to Bournemouth. The purchase will take place on the same terms as Bournemouth had agreed to pay to the company; Bournemouth will pay for the lease a price equal to the principal and interest of the purchase money, which sum would be borrowed for 30 years, and at the end of that period the lease would expire, and Poole and Branksome (if the latter joins in) would become joint owners of the system. Any extension which Poole may wish for shall, if reasonable (and the Board of Trade will be asked to decide that), be carried out. Poole will construct the lines and Bournemouth will work them on the same terms as apply to the existing lines. The chairman of the Tramways Committee considers this settlement to the advantage of both towns, whilst at the end of 30 years the trams will belong to Poole for nothing, whereas if purchased from the company the fair market value would have to be paid.

**Spain.**—The contract for the construction and equipment of an electric tramway between Linares and Las Minas has been secured by La Sociedad La Industria Electrica, of Barcelona.

**Sunderland.**—At the meeting of the T.C. on the 8th inst. the question of extending the Corporation tramways to the east end of the town, where are situate the extensive docks, was again debated, and it was finally decided to immediately proceed with the work of constructing a double line by way of Hudson Road and Lawrence Street. There has been great opposition to this route on the part of the East Ward representatives, who urge that any route to that quarter should go by way of High Street, the chief artery of the town, but in which the gradient is very steep and erratic, there being a heavy decline and then as serious an ascent. There were not any serious engineering difficulties in the way; it was purely a matter of cost. The contour of the street would have had to be altered. Mr. Summerbell, in proposing the motion for the construction of the Hudson Road route, said the total cost of a double line would be £13,682 without cars. He said it behoved them to be careful in their proceedings; for while the Act authorised them to expend £300,000 they were now approaching that limit. Mr. Bryers, in seconding the motion, said that they would save £2,100 on the route as laid down in the proposed scheme as against the alternative route, and also £5,300, which in the latter case would have to be spent on the alteration and other highway work.

**Torquay.**—Proposals *re* electric tramways have been received from four companies, and the matter is to be reported upon by the special Tramways Committee.

## TELEGRAPH AND TELEPHONE NOTES.

**Glasgow Telephones.**—At the Council meeting on 3rd inst. the Convener of the Telephone Committee stated that his Committee had made representations to the Finance Committee that the National Telephone Co. only paid £3 for wayleaves for 8,000 wires over the various public parks, and that in view of the company's refusal to allow a Corporation telephone call office in the Royal Exchange, an adjustment was surely necessary. Several Councillors advocated more friendliness between the company and Corporation in the matter. The Corporation has now 8,504 telephones in operation with 30,000,000 messages per annum. There are 15 switchrooms. The company have just finished considerable and much needed improvements and now offer an unlimited local service for £5 per annum.

**Telegraph Wire Export Trade.**—March proved an active month as regards the export trade of this country in telegraph wire and cables, and apparatus connected therewith, the month's shipments amounting to no less than £230,280 as compared with only £19,676 in February last, and £36,740 in March, 1902. So far as the year has gone, however, this branch of trade has been very quiet, the shipments during the three months ending with March having reached a total of only £341,033, which compares with £749,355 in the first three months of 1902.

### Telegraphic Interruptions and Repairs :—

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Latakia-Cyprus | June 20, 1899 | |
| Trinidad-Demerara No. 1 | Aug. 27, 1901 | |
| Dominica-Martinique | May 8, 1902 | |
| St. Lucia-Martinique | May 8, 1902 | |
| Guadeloupe-Martinique | May 9, 1902 | |
| Martinique-Puerto Plata | July 10, 1902 | |
| Guantanamo-Mole St. Nicholas | Aug. 4, 1902 | |
| Cayenne-Pinheiro | Aug. 13, 1902 | |
| St. Lucia-St. Vincent | Sept. 19, 1902 | |
| Reisa-Issa | Oct. 22, 1902 | |
| Reisa-Yemani | Oct. 22, 1902 | |
| Paramaribo-Cayenne | Feb. 27, 1903 | |
| Zanzibar-Mombasa | March 6, 1903 | |
| Jamaica-Colon | Mar. 12, 1903 | |
| New York-Haiti | April 13, 1903 | |

**Wireless Telegraphy in Canada.**—A company has just been formed in Toronto with a capital of £500,000, to be known as the De Forest Wireless Telegraph Co., of Canada, to acquire the patents of Mr. Lee de Forest, and to operate a system of wireless telegraphy in the Dominion.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Argyll.**—April 21st. Electric light installation for the Sandbank special lighting district for the Cowal District Committee of the County Council of Argyll. Mr. J. Andrew, engineer, Burgh Buildings, Dunoon.

**Aston Manor.**—April 17th. Free wiring and motors for the U.D.C. See "Official Notices" April 3rd.

**Austria.** — May 1st. The Laa-am-Thaya (Lower Austria) Communal Council wants offers for the establishment of a central power station for the production of energy and lighting by gas or electricity.

**Bath.**—April 20th. One 500-KW. steam dynamo, 200-KW. balancer, water-tube boiler, &c. See "Official Notices" April 3rd.

**Bath.**—April 27th. Cables for Corporation electricity supply extensions. See "Official Notices" April 10th.

**Batley.**—April 18th. Eight electrical cars. See "Official Notices" March 27th.

**Bedford.**—April 20th. One water-tube boiler for the electricity works. See "Official Notices" April 3rd.

**Bridlington.** — April 21st. Two 100-KW. steam dynamos, booster, crane, Lancashire boilers, battery, switchboard, mains, piping, street lamps, &c., for the electric lighting scheme. See "Official Notices" March 27th.

**Brighton.**—June 8th. The Council wants tenders for 5,400 KW. generating plant at Southwick power station, and 5,000 KW. motor-generator converting plant, together with switchboards, instruments, &c., at North Road power station. See "Official Notices" to-day.

**Cairo (Egypt).**—May 12th. The Egyptian Government is inviting tenders for an installation for the transmission of power for public and private purposes at Ghiza and Jhezira. See this column for April 3rd.

**Darlington.**—April 18th. Overhead equipment, switchboard extension, booster and battery, for the Corporation light railways. See "Official Notices" March 27th.

**Eccles.**—April 18th. Lancashire boiler, engine, alternator and other plant; also free wiring. See two "Official Notices" March 27th.

**Edinburgh.**—May 4th. Electricity meters (12 months' supply). See "Official Notices" to-day.

**Faversham.**—April 27th. Two 80-B.H.P. oil engines, battery, switchboard, and mains. See "Official Notices" April 3rd.

**France.**—April 21st. Tenders are being invited until the 21st inst. by the French Post and Telegraph Authorities in Paris, for the supply of eight lots of telegraphic apparatus. Tenders are to be sent to Le Sous-Secretariat des Postes et des Telegraphes 103, Rue de Grenelle, Paris, whence particulars may be obtained.

**Glasgow.**—May 4th. Cables, meters, carbons, &c., for the electrical department. See "Official Notices" April 10th.

**Glasgow.**—May 5th. Carbons, rubber cables, &c., for the electricity department. See "Official Notices" to-day.

**Govan.**—April 27th. Battery, boosters, switchboards. See "Official Notices" April 10th.

**Great Yarmouth.**—April 22nd. High-tension cables for electric lighting. See "Official Notices" April 10th.

**Hackney.**—April 30th. Ferranti switchboard extensions, &c., piping and valves, and meters for the Council. See "Official Notices" April 3rd.

**Ipswich.**—April 27th. Piping, pumps, &c., for the electricity scheme. See "Official Notices" March 27th.

**Islington.**—April 21st. Mains (solid) extensions and supply meters. See "Official Notices" April 3rd.

**Kettering.**—May 1st. Boilers, engines, dynamos, battery, switchboard, lamps, mains, &c., for electric lighting installation. See "Official Notices" April 3rd.

**Maidenhead.**—April 21st. One 200-KW. steam dynamo, and one water-tube boiler. See "Official Notices" March 27th.

**Newport (Mon.).**—April 27th. Two multipolar motors. See "Official Notices" April 10th.

**Rangoon.**—July 1st. The Municipal Committee wants tenders for carrying out its electric lighting license, and particulars, forms, &c., can be obtained from the officiating secretary (W. Shircore), Rangoon municipality, at Rs. 75 per set.

**Roumania.**—April 28th. The Municipal Authorities of Constanza are inviting tenders until the 28th inst. for the lighting of the town either by gas or electricity.

**Sheffield.**—May 2nd. Piping and high-tension switchboard for the Neepsend new power station. See "Official Notices" to-day.

**Southwark.**—April 29th. 50 meters, boards, fuses, &c. See "Official Notices" to-day.

**Swindon.**—April 21st. Cables for 12 months. See "Official Notices" April 10th.

**Wakefield.**—April 18th. Boiler, condenser, and other details. See "Official Notices" April 3rd.

**Whitby.**—April 30th. Mechanical stokers and induced draught fan for the electricity department. See "Official Notices" to-day.

### CLOSED.

**Barnsley.**—The Corporation Electricity and Lighting Committee has accepted the tender of Messrs. Bruce Peebles & Co., for a new engine and dynamo at the electricity works at £2,673.

**Belgium.**—Four firms submitted tenders for the supply of 18 electrically-operated capstans for the new quays on the Scheldt at Antwerp, the lowest being that of La Compagnie Internationale d'Electricité, of Liège, which quoted £3,430.

**Bradford.**—The Council last week resolved to order two 1,000-kw. direct-current electric generators for the new generating station, Valley Road, from the British Westinghouse Co.

**Darlington.**—The T.C. has accepted the tender of the British Westinghouse Co. for the supply of tramcars of the single-deck combination type at £500 each.

**Fulham.**—The Borough Council has accepted the tender of Messrs. Rowland Carr & Co, for the supply of service boxes, ventilated frames and covers, and bitumen compound, for the electricity department.

Paper insulated cables, conduits, arc and incandescent lamps, &c., are to be supplied by Henley's Telegraph Works Co. Messrs. Henley, have secured the contract for 12 month's supply of cables for the Sunderland Corporation.

**Grantham.**—The T.C. on April 2nd accepted the tender of Messrs. Manlove, Alliott & Co. for the supply of a refuse destructor.

**Grimsby.**—For installing the electric light in the Higher Grade Schools for the T.C.:—

| | |
|---|---|
| Appleyard & Staths, Hull | £440 |
| Crowther & Co., Manchester | 710 |
| Dickens, A. C., Grimsby (accepted) | 227 |
| Hyde, H., Hull | 322 |
| Kennington & Dolby, Grimsby | 299 |
| King & Co., Hull | 512 |
| Northern Electrical Co., Grimsby | 295 |
| Robinson & Emerson, Grimsby | 395 |
| Wallace, Chas., Grimsby | 334 |
| Wokes, Chas., & Co., Hull | 325 |

**Huddersfield.**—The Tramways Committee has accepted the tender of the British Electric Car Co. for the conversion of 12 bogie cars, to the single truck principle on the condition that the Corporation have the option of having the remainder of their bogie cars so converted.

**London.**—The L.C.C. Fire Brigade Committee has placed the contract for wiring the Mile End station for lighting and bells with Mr. W. H. Johnson at £230.

**Newport (Mon.).**—Coal handling apparatus for Corporation power station is to be supplied by Messrs. Rees & Kirby, Ltd., Morriston, at £250.

**Pemberton.**—The U.D.C. has accepted the tender of Mr. W. Winnard, of Wigan, for the construction of the Warrington Road tramway.

**Redditch.**—The T.C. has accepted the tender of Messrs. Willans & Robinson for the supply of a 350-H.P. gas engine for the Electricity Works at £3,750.

**Salford.**—Messrs. Veritys, Ltd., of Manchester, have secured the contract for supplying motor-starting switches for the Salford Corporation for the ensuing 12 months. This is the second year in succession that the firm have obtained this order.

**War Office.**—A contract has been given to the B.T.H. Co. for a number of B.T.H.-Edison incandescent lamps, for 100 and 210-volt circuits.

**Sheffield.**—The following tenders have been accepted by the T.C.:—Messrs. G. C. Milnes, Voss & Co., of Birkenhead, for 30 tramcar roof covers, at £47 10s. each; Pendleton Ironworks Co., of Manchester, for roof principals and constructional steel work at the new power house at Neepsend, £1,668; Messrs. Ernest Newell and Co., of Gainsborough, for coal shoots, ash elevator and tank, water tank, &c., at the new power house, £1,429; The Chatteris Engineering Co., Ltd., of London, for overhead travelling cranes for the engine room, and coal siding at the new power house, £1,062.

**Sunderland.**—The T.C. has accepted the following tenders:—Messrs. Alley & McLellan, surface condenser; S. Warburton, Manchester, erection of a sub-station; Henley's Telegraph Works Co., india-rubber-covered cables; Green & Sons, fuel economiser; Doulton & Co., stoneware casings; Wearmouth Piping Co., steam piping; British Insulated Wire Co, high-tension cables; Callender's Cable Co., cables. An electric air compressor for the high-tension machinery is to be obtained at a cost of £70.

## FORTHCOMING EVENTS.

Monday, April 20th.—At 5 p.m. Junior Institution of Engineers. Visit to the Brook Green Works of the Incandescent Electric Lamp Co.

Tuesday, April 21st.—I.E.E. (Manchester). Paper by A. H. Gibbings on "The Carriage of Goods on Electric Tramways," with lantern views. This is the last meeting for the session. [Annual meeting will be held at 7.15 p.m. for the election of officers, &c., for the coming session.]

At 8 p.m. Institution of Civil Engineers. "The Decay of Metals," by J. T. Milton and W. J. Larke.

Thursday, April 23rd.—At 8 p.m. I.E.E. (London). "Distribution Losses in Electric Supply Systems," by A. D. Constable and E. Fawsett; "A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms," by M. B. Field. (Adjourned discussion.) If time permits, "Divided Multiple Switchboards: An Efficient Telephone System for the World's Capitals," by W. Aitken. [In accordance with Art. 45, the announcement of the Council nominations for the Council of 1903-4 will be made at this meeting.]

Friday, April 24th.—At 9 p.m. Royal Institution. Discourse by the Hon. R. J. Strutt, M.A., on "Some Recent Investigations on Electrical Conduction."

At 8 p.m. Junior Institution of Engineers. Westminster Palace Hotel. Paper on "The Effect of Design on Methods of Construction from a Contractor's Point of View," by R. W. Newman, M.I.Mech.E. (Vice-Chairman).

## NOTES.

**Platinum Electrodes.**—Platinum is a metal which is being used to an increasing extent as electrode material in industrial electro-chemistry. On the one hand, in the form of an alloy of platinum and iridium, its resistance to attack by acids and alkalies renders it superior to all other metals or elements for this purpose; and, on the other hand, improvements in the mechanical design of electrodes formed of platinum have enabled electrochemists to obtain a very large area of electrode surface of this metal at a moderate cost as regards capital outlay. The faith in the resistance of platinum to attack by all solvents excepting *aqua-regia*, is, in fact, wide-spread, and it is somewhat startling to learn from a recent research carried out by Herr F. Glaser, in the laboratory of the Carlsruhe Technische Hochschule, that, under certain conditions, platinum loses its rank as one of the so-called "noble" metals, and sinks to the level of those base metals which decompose water in presence of alkalies.

Herr Glaser has been investigating the cause of the discrepancy noted when mercury is electro-deposited from a cyanide solution upon a platinum basin. When using a sulphate or nitrate solution, the deposition of mercury occurred in accordance with Faraday's law, and the whole of the mercury could be obtained at the cathode. With a cyanide solution, on the other hand, a deficiency in the weight of mercury obtained was always noted; and after numerous experiments Herr Glaser has proved this to be due to the solution of platinum in the cyanide solution, and to the consequent loss of weight at the cathode. The attack of potassium cyanide on platinum is found to be slow at ordinary temperatures, but it increases rapidly with rise of temperature, and the presence of potassium amalgam greatly accelerates it. The solution of the platinum in potassium cyanide occurs under exclusion of the oxygen of the air, and is allied with an evolution of hydrogen. Further details of this interesting and important research will be found in the *Zeits. f. Elektrochemie* of January 1st, 1903.

**Will.**—The inventory of the estate of the late Hugh Steven, of Messrs. McDowall, Steven & Co., Ltd., Glasgow, amounts to £75,244.

**Electrical Treatment for Cancer.**—The newspaper press asserts that the report of the Cancer Commission, when made public, will be found to recommend the high frequency electrical treatment.

**A Refresher!**—At last, and just when one had ceased to hope for Britain's originality, one reads in an American journal that New York has been taking lessons in England, and has been profiting by them to the admiration of all beholders. The *Street Railway Journal* for March 28th reports that much of the heavy congestion at the busy crossings in New York has been lessened by the introduction of "London methods." For years the apparently miraculous way in which the man on point duty regulates the flow of the densest London traffic with the little finger has been a source of astonishment to every fresh American, to say nothing of the rest of the world; and it is difficult to understand why some trial of the method has not been made in America before now. Possibly it was thought that a people used to being "clubbed" would not take kindly to gentler suasion. The situation in New York has been growing utterly intolerable of late, and it has been quite impossible to put sufficient cars on the city lines to serve the populace, because the cars already running were continually blocked. Now that rational police methods have been introduced the primary and chief cause of this congestion—strangulation was nearer the mark—is found to have been the chaotic jumble of traffic, in which everyone and everything, except the unfortunate cars, went where they pleased, when they pleased. Direction is now in vogue, "and merchants and bankers, professional men and clerks, artisans and labourers, gather daily at these places to look on and applaud." That is nicely enthusiastic and flattering, but one would like to suggest that "London methods" in their fulness would find a spare policeman to move that applauding crowd onwards! Hitherto the worst offenders in the eyes of the street railway men have been the heavy dray men, who have insisted upon travelling at two miles per hour along the tracks, with a breakdown every other block. Consequently the companies have not been able to carry out their obligations to the public, and while being called all manner of names by the public, have been at a pecuniary loss themselves. They were not long in cornering the disease, but it has taken a weary time to induce the city authorities to apply the remedy. They should rejoice now to see the heavy vehicular traffic kept strictly to that portion of the street between the tracks and the kerb. New York is by no means the only city in the U.S.A. in which the same complaint is rife, and it is to be hoped that the "London methods" will spread. The training of a few policemen should be a less expensive matter, even in New York where a policeman is a very expensive article, than the construction of subways for the cars, which seemed to be the only thing left to be done.

**Physical Tests for the Purity of Ammonium Chloride for Voltaic Elements.**—M. G. Rosset, in the *Centralblatt. f. Accumulatoren u. Elementenkunde* for February 1st, gives details of two useful physical tests for determining the purity of ammonium chloride intended for battery use. These tests can be carried out by anyone with comparatively simple apparatus, and they enable 5 per cent. of sodium chloride (the most usual adulteration of the ammonium salt) to be detected with ease. The two tests are based on the change in the coefficient of heat absorption, and in the specific gravity, when sodium chloride is present as an impurity. The change in the coefficient of heat absorption is most marked with dilute solutions, and when 25 grs. of the salt are used in 250 cc. of water, the temperature and coefficient variations are as follows:—

| | Fall in temperature. | Coefficient of absorption.* |
|---|---|---|
| Pure ammonium chloride ... ... | 6·0° C. | ·24 |
| $NH_4Cl$ with 5 per cent. Na Cl ... | 5·75° C. | ·23 |
| " 10 " " ... | 5·50° C. | ·22 |
| " 15 " " ... | 5·25° C. | ·21 |
| " 20 " " ... | 5·00° C. | ·20 |
| " 25 " " ... | 4·75° C. | ·19 |
| Pure sodium chloride ... ... | 1·50° C. | ·06 |

$$\text{* Coefficient} = \frac{\text{fall of temperature}}{\text{weight of dissolved salt}}$$

As regards the check test, the specific gravity of a saturated solution of pure ammonium chloride at 15° C. is 1·0766, and should such a solution show a higher specific gravity at the temperature named, this signifies the presence of sodium chloride, or some other impurity. The following figures show the variations in specific gravity caused by increasing percentages of sodium chloride, when using a solution containing 25 grs. of the ammonium chloride in 250 cc. of water:—

| | |
|---|---|
| Ammonium chloride, pure ... ... ... | 4·33 Baumé |
| " " with 10 per cent. NaCl | 5·00 " |
| " " " 20 " " | 5·50 " |
| Sodium chloride, pure ... ... ... ... | 9·00 " |

For carrying out the temperature-depression test, it is advisable to use a thick glass flask of about 1 litre capacity, and after vigorously shaking the weighed quantity of salt with 250 cc. of water, to quickly read the temperature of the immersed thermometer. As the depression occurs in from ½ to ¾ minute, no time must be lost in noting it, and it is further necessary to start the test with both the salt and water at the *same temperature*—preferably that of the room.

**A Malay Electrical Scheme.**—The Government of Selangor, one of the Malay Federated States, has just commenced an electrical transmission scheme for supplying light and power to the town of Kuala Lumpur from some waterfalls on the Gombak River, about 13 miles from the town. An open ditch, lined with concrete, is carried round a contour line on adjacent hills, at a height of about 300 ft. above the power station. The latter will contain two 600-H.P. turbines by Messrs. Escher, Wyss & Co., of Zurich, direct coupled to three-phase generators by the Oerlikon Co., of the same town. The current is generated at 6,600 volts, and supplied direct to the motor-generators in the sub-station, without transformation. The transmission line will consist of three No. 0 copper wires, carried 2 ft. apart in an equilateral triangle, on porcelain insulators on steel poles. The distribution in the town will be on the three-wire system, with about 500 volts across the outers. The streets of the town are to be lighted by arc lamps in the centre of the town and incandescent lamps in the less densely populated portions. With the exception of the equipment of the power station and sub-station, all material is being supplied from England. The civil engineering work is being carried out by Mr. E. H. Wallich, and the electrical by Mr. H. B. Phillimore, both acting under the State engineer, Mr. P. McGlashan. The town of Kuala Lumpur is prettily situated, in the State of Selangor. The population is largely Chinese. There are numerous tin mines and coffee plantations in the State, which will probably be anxious to benefit as soon as possible by the use of electricity for power.

**Manufacture of Calcium Carbide Cartridges.**—An Austrian patent has been taken out by E. von Szalay, of St. Petersburg, for an improved method of making cartridges from carbide of calcium. The material is first powdered, then compressed under a powerful pressure until it has cohered into masses of the desired shape and size. Next these cakes are immersed in petroleum or some similar oil to protect them from the attack of atmospheric moisture. Other patents have been obtained, especially in the United States, for processes in which powdered calcium carbide is first treated with petroleum and then moulded to shape by high pressure; but these are said not to have proved satisfactory because the carbide took up so much oil that it did not afterwards decompose thoroughly when immersed in water. It is claimed for the opposite method of procedure that the compressed dust absorbs less oil, and so the cartridges decompose properly, while yet they retain their form if exposed to air. Cartridges of carbide have the advantage over the ordinary material that they are uniform in size, shape, weight and composition, so that they always yield the same amount of acetylene, and decompose in a regular fashion. They are chiefly suitable, naturally, for small or portable acetylene generators, because the expense involved in converting the carbide into cartridge form makes the gas evolved more costly per unit of volume or light than it otherwise would be.

**Peculiar Accident on an American Railroad.**—The *Street Railway Journal* records a peculiar accident which recently happened on the road of the Columbus, Buckeye Lake and Newark Traction Co. to a motor-car going west from Newark toward Columbus about 9·30 o'clock at night. Some malicious persons had tied a rope to a large stone and thrown the other end of the rope over the trolley wire. As the car was going at the rate of about 25 miles an hour, the stone went through the front window, striking the motorman on the head and knocking him off the stool. The cars are equipped with the General Electric multiple controller, and it is necessary at all times for the motorman to hold down the spring on the handle. As soon as his hand was removed from this spring the power was cut off; consequently the car stopped. The conductor, after giving two bells to proceed and receiving no response, went through the car to the front end and found the motorman lying unconscious in the vestibule. The general manager of the company says that but for this precautionary device the car would probably have run off the track at the approaching curve, and might possibly have run into the canal. An accident of this kind is extremely improbable on any English railway, especially bearing in mind the fact that there are always two persons in the cab.

**Personal.**—Mr. T. W. Robinson, late car-shed foreman of the Southend Electric Trams, has been presented by the car-shed staff with a silver vesta case.

Mr. Frank B. Lea announces that his address is now Baltic Chambers, 50, Wellington Street, Glasgow, and all communications for the B.E.T. Co. or himself in regard to the company's Scottish business should be sent there.

Sir Henry Christopher Mance, C.I.E., has received the honorary degree of LL.D. of Aberdeen University.

Mr. A. F. C. Peel, manager of the Lancaster and District Tramways, on leaving Lincoln, has been presented with a pedestal writing desk as a farewell gift, by residents of the city, and a silver mounted pipe by the tram employés.

Mr. T. Marshall, electrical engineer to Messrs. Lea, Son & Co., Pengwerne Works, Shrewsbury, who has secured an appointment at Kettering, has been presented by the firm's employés with a fitted Gladstone bag.

At a concert of the employés of Messrs. Johnson & Phillips, Old Charlton, held at the Angerstein Hotel on April 8th, Mr. Edward Pearce was the recipient of a gold albert and engraved pendant on the occasion of his leaving the firm after 20 years' service in the arc lamp department.

**St. Louis Exhibition, 1904.**—The driving of 125 piles for the power house, the only "poured" building to be erected on the Fair grounds, was begun on March 25th. Around a steel framework walls of cinder concrete 3 in. thick will be poured, to form a continuous wall without joint or seam. The piles are for the heavy iron columns which will support the steel truss roof. The building will be 220 by 300 ft., and cost about $100,000. The steel trusses, 36 in number, will have a 75-ft. span, each weighing about 10,000 lbs. The area between the boiler house and the machinery buildings will be given up to cooling towers, briquette machines, &c. Coal will be taken in from the western side of the house. Automatic conveyances provided with crushers and screens will handle the fuel without the interposition of labourers.

**Glasgow University Engineering Students' Society.**—The students of this society, along with the engineering students of University College, London, are spending Easter at Birmingham visiting works. They have been much struck by the general adoption of electricity for power purposes in all the large engineering shops.

**Appointment Vacant.**—Borough electrical engineer and tramways manager at £300 for Burton-on-Trent. See "Official Notices" to-day.

**Electricity in Mining.**—The underground electric haulage plant at the Great Southern Consols Mine, Rutherglen, has been in full operation for some months with most satisfactory results, and gives a good illustration of the saving to be effected by the use of electricity, intelligently applied, over the old system of horse traction. The *Sydney Bulletin* says that, although the tracks are not yet in the best condition, or the men quite used to the new system, the manager states the expenses are £7 per day less, with an increased quantity of dirt handled. The plant was supplied and installed by the Austral Otis Engineering Co., of South Melbourne, and is of Ganz manufacture.

**Business Announcement.**—Messrs. Power, Power and Co., of 5, Philpot Lane, E.C., have purchased the goodwill, business and works of Deane, Ransome & Co., Ltd., of Plymouth Wharf, Wharf Road, Cubitt Town, E., where they will continue the manufacture of girders, roof work and constructional iron and steel work generally as hitherto.

**Chesterfield Tramways.**—A report was recently prepared on the proposed conversion of the existing horse lines to overhead electric traction and certain extensions, by the borough electrical engineer, Mr. R. L. Acland. The matter was before the Council on the 14th inst., when it was decided to call a town's meeting to test the feelings of the public.

## THE CENTRAL STATION ENGINEER.

Worthing T.C. has increased the salary of Mr. Porter, resident electrical engineer, from £250 to £300 per year.

Mr. Hugh B. Phillimore has just arrived at Kuala Lumpor, the chief town in the Malay Federated States, to take up his duties as resident electrical engineer to the State of Selangor.

The members of the staff of the East London (Cape Colony) Municipal Electrical and Tramways Department lately assembled in order to present a photograph of themselves and an illuminated address to Mr. E. G. Jones, their late chief, who was leaving the town in order to take up more important duties elsewhere. Mr. C. W. Moore, the newly appointed electrical engineer, presided. The health of Mr. Jones and Mr. Moore was toasted, and the proceedings, which were of a very pleasant character, concluded with the singing of "Auld Lang Syne."

Mr. F. J. Rynd has resigned the position of chief assistant engineer at the Portsmouth electricity works in order to take up a post with the Electrical Co., Ltd., of 25, Victoria Street, S.W. He will be succeeded by Mr. Hiscock.

Mr. F. C. Sellons, of Wandsworth, has secured the appointment as engineer-in-charge recently advertised by the County of Durham Electrical Power Distribution Co., Ltd.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Eastern Telegraph Co., Ltd.** (6,338).—Issue on March 25th of £3,000 debenture stock, being the whole of a series created same date, charged on the company's undertaking and revenue, ranking *pari passu* with previous issues amounting to £1,823,845. Holder: F. R. de Levante, 141, Hill Street, Peckham, S.E.

**Frinton-on-Sea and District Electric Light and Power Co., Ltd.** (70,069).—A debenture dated March 30th, 1903, securing £100, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: W. Webster, 50, Lee Park, Blackheath.

**Hart Accumulator Co., Ltd.** (60,059).—This company's annual return was filed on March 23rd, when the entire capital of £40,000 divided into 40,000 shares of £1 each had been taken up. £1 per share has been called up on 17,500 shares, resulting in the receipt of £17,500. 22,500 shares are considered as fully paid. No mortgages or charges.

**Anglo-American Telegraph Co., Ltd.** (2,891 C.)—This company's annual return was filed on March 4th, when the entire capital, consisting of £7,000,000 stock, had been taken up and paid in full. No mortgages or charges.

**Consolidated Telephone Construction and Manufacturing Co., Ltd.** (15,212).—This company's annual return was filed on March 3rd, 1903, when 244,850 10s. ordinary shares had been taken up and paid for in full out of a nominal capital of £234,938 divided into 47,363 preference shares of £1 each, 244,850 ordinary shares of 10s. each, and 75,150 ordinary shares of £1 each. Mortgages and charges, £9,500.

**St. James's and Pall Mall Electric Light Co., Ltd.** (26,015).—This company's annual return was filed on March 12th, when the entire capital of £300,000, divided into 40,000 ordinary and 20,000 preference shares of £5 each, had been taken up. £5 per share has been called up on 39,650 ordinary and 20,000 preference shares, resulting in the receipt of £298,250. £1,750 is considered as paid on 350 ordinary shares. Debenture stock, £150,000.

**Uxbridge and District Electric Supply Co., Ltd.** (62,706).—Issue on March 31st of £2,000 debentures, part of a series created July 18th, 1901, to secure £20,000, charged on the company's undertaking and property present and future, including uncalled capital. No trustees. Total amount previously issued of same series, £18,000.

## ELECTRICITY SUPPLY ACCOUNTS.

### Hastings Corporation Electricity Department.

We give herewith an analysis of the accounts of the Hastings undertaking for the year ending December 31st, 1901. During the year the output in units and the revenue have shown substantial increases, and working expenses being practically stationary, an increased profit has resulted. Since the Corporation acquired the undertaking its progress will be gathered from the following figures:—

| Year. | Equivalent number of lamps. | Number of consumers. | Units sold. | Average revenue per unit. sold. | Total costs per unit. |
|---|---|---|---|---|---|
| 1899 ... | 19,423 | 378 | 404,866 | 6·79d. | 3·78d. |
| 1900 ... | 23,864 | 484 | 524,830 | 5·21d. | 3·66d. |
| 1901 ... | 29,428 | 604 | 703,814 | 3·16d. | 3·19d |
| 1902 ... | — | — | 803,761 | 3·06d. | 2·75d. |

Of the total quantity of energy sold 575,568 units were taken by private consumers, and 228,193 units (at 1½d.) for public lighting. The prices charged are 6d. per unit, or 10s. per 8-c.p. lamp per annum and 1½d. per unit, street lighting £15 per kw. demanded and 1½d. per unit. The system of supply is h.t. alternating at 2,000 volts transformed down for two and three-wire l.t. distribution networks at sub-stations. Mr. R. F. Ferguson is the borough electrical engineer.

General Statement.

| For the year ending December 31st— | 1901. | 1902. |
|---|---|---|
| Total capital expended ... ... ... | £123,405 | £128,944 |
| Number of units sold ... ... ... ... | 703,814 | 803,761 |
| Equivalent number of 8-c.p. lamps connected | 29,428 | — |
| Number of public lamps ... ... ... | 104 | 104 |
| Maximum load in kilowatts ... ... | 584 | 601 |
| *Revenue Account:*— | | |
| Gross revenue ... ... ... ... | £14,799 | £16,894 |
| „ expenditure ... ... ... | £9,237 | £9,220 |
| „ profit ... ... ... ... | £5,562 | £7,674 |
| Average price per unit ... ... ... | 3·16d. | 3·06d. |

Revenue Account.

| | Gross. | Per unit |
|---|---|---|
| Sale of energy ... ... ... ... ... | £10,210 | 3·06d. |
| Lamp charge ... ... ... ... ... | £4,507 | 1·34d. |
| Interest and sinking fund on cost of lamps, posts, &c., repairs, carbons, trimming, &c. | £1,394 | ·42d. |
| Meter rental, &c. ... ... ... ... | £783 | ·23d. |
| Total ... ... ... ... ... ... | £16,894 | 5·05d. |

Working Expenses.

| | Gross. | Per unit. |
|---|---|---|
| Coal ... ... ... ... ... ... ... | £4,139 | 1·24d. |
| Oil, waste, water and engine room stores ... | 434 | ·13d. |
| Wages incurred in generating, distribution and attending public lamps ... ... ... | 1,431 | ·42d. |
| Maintenance and repairs of engines, dynamos, mains, transformers, public lamps, &c. ... | 1,333 | ·40d. |
| Works and distribution costs ... ... | £7,337 | 2·19d. |
| Rents, rates and taxes ... ... ... ... | 194 | ·06d. |
| Management expenses, salaries engineer, secretary and clerical staff ... ... ... | 969 | ·29d. |
| General establishment charges, stationary, printing, law insurance and sundry ... | 720 | ·21d. |
| Total costs ... ... ... ... ... | £9,220 | 2·75d. |

Profit Statement.

| | |
|---|---|
| Debit balance at December 31st, 1901, brought forward ... ... ... ... ... ... | £3,438 |
| Redeemable stock dividends and bank interest... | 4,435 |
| Bad debts ... ... ... ... ... ... | 16 |
| Loans and sinking funds ... ... ... ... | 4,302 |
| Debit balance at December, 1902, carried forward ... ... ... ... ... ... | −4,518 |
| Gross profit ... ... ... | £7,674 |

The works costs are not excessive compared with undertakings similarly situated, but the prices obtained are below the average.

The gross profit of £7,674 is insufficient to meet the financial charges, and as a result the debit balance carried forward is swelled to £4,518.

### St. James's and Pall Mall Electric Light Co., Ltd.

We give this week an analysis of the accounts of the St. James's Co. for the year ending December 31st, 1902.

Financially the undertaking is probably the most successful in the London area, the dividends for the year and for some time previously having been at the rate of 14½ per cent., in addition to which they have provided for depreciation an amount equal to 3·66 per cent. on the capital.

During the year the capital expended has increased by £5,967. The progress of the company during recent years will be gathered from the following:—

| Year. | No. of lamps. | No. of units sold. | Max. load in kw. | Load factor. | Cost per unit. |
|---|---|---|---|---|---|
| 1898 | 142,853 | 3,448,858 | 2,825 | 14·0 % | 1·98d. |
| 1899 | 164,750 | 4,201,104 | 3,216 | 14·9 % | 1·98d. |
| 1900 | 186,347 | 5,127,775 | 3,624 | 16·1 % | 1·93d. |
| 1901 | 211,827 | 5,842,496 | 3,996 | 16·7 % | 2·1d. |
| 1902 | 232,685 | 6,785,960 | 4,380 | 17·7 % | 1·83d. |

The works of the company are situated at St. James's Square and Carnaby Street, W., the system of supply is three-wire low pressure at 214 volts on the outers, and the total capacity of plant installed is 5,480 kw. Mr. Sydney T. Dobson is the chief engineer. The prices charged are 6d. per unit up to 4,000 units per annum and 4d. per unit after. Power and basement lighting 3d. per unit up to 4,000 and 2d. per unit after. Public arcs at £30 per annum.

GENERAL STATEMENT.

| For year ending December 31st— | 1902. | 1901. |
|---|---|---|
| Total capital expended ... ... ... | £429,379 | £423,412 |
| Number of units sold... ... ... ... | 6,785,960 | 5,842,496 |
| Equivalent number of 8-c.p. lamps ... ... | 232,685 | 211,827 |
| Number of public arcs. ... ... ... | 60 | — |
| Maximum load in kilowatts ... ... ... | 4,380 | 3,996 |
| *Revenue Account:*— | | |
| Gross revenue ... ... ... ... | £117,136 | £104,913 |
| „ expenditure ... ... ... | £51,852 | £51,396 |
| „ profits ... ... ... ... | £65,284 | £53,517 |

REVENUE ACCOUNT.

| | Gross. | Per unit. |
|---|---|---|
| Sale of energy (private, contract and public lighting) ... ... ... ... | £113,550 | = 4·02d. |
| Meter rental ... ... ... ... ... | 3,054 | ·10d. |
| Discounts, sundry fees, sale of old material, Coronation illuminations, &c. ... ... | 532 | ·02d. |
| | £117,136 | 4·14d. |

WORKING EXPENSES.

| | Gross. | Per unit. |
|---|---|---|
| Coal, &c. ... ... ... ... ... ... | £18,518 | 65d. |
| Oil, waste, water and engine-room stores ... | 1,900 | ·07d. |
| Salaries and wages incurred in generating and distribution. | 8,768 | ·31d. |
| Repairs and maintenance of buildings, machinery, public lamps, mains, &c. | 5,947 | ·21d. |
| Works and distribution costs ... | £35,133 | 1·24d. |
| Rent, rates and taxes ... ... ... ... | 7,810 | ·28d. |
| Management expenses, directors' fees, salaries of manager, engineer, clerical staff, auditors. | 7,214 | ·25d. |
| General establishment charges, printing, stationery, advertising, law, insurance, and sundry. | 1,695 | ·06d. |
| Total costs ... ... | £51,852 | 1·83d. |

PROFIT STATEMENT.

| | |
|---|---|
| Interest on debentures ... ... ... ... | £5,250 |
| Transferred to reserve fund ... ... ... | 5,792 |
| Transferred to contingency fund ... ... ... | 5,000 |
| Balance, applicable to dividends ... ... ... | 38,793 |
| Brought forward from last account ... ... | — 4,094 |
| Provision for depreciation ... ... ... ... | 14,543 |
| Gross profit on year ... ... ... | £65,284 |

The total balance consists of £65,284, and a sum of £4,094, being the balance from the previous year, and interest accumulated during the year. After paying interest on debentures and providing for depreciation, reserve and contingencies, a balance of £38,793 was left for distribution as dividends, and a net balance of £2,792 carried forward.

## CITY NOTES.

### Reading Electric Supply Co.

THE directors' report for the year 1902 shows that the expenditure on capital account amounted on December 31st, 1902, to £112,750. In August, 1902, the directors issued 2,000 shares of £5 each, and offered the same to the existing shareholders in proportion to their holdings, the whole of the shares issued being subscribed. In order to provide further working capital the directors, on March 20th, 1903, resolved to issue 2,000 more shares, and to offer the same as before to the existing shareholders in proportion to their holdings. In pursuance of such resolution, a prospectus and form of application for shares are sent to each shareholder with this report. The total revenue for the year was £12,050; and the expenditure connected with the generation and distribution of electricity, management expenses, and the sum of £1,250 written off to depreciation fund account, amounted to £6,646; leaving a profit balance on the year's working of £5,404, which is carried to the credit of net revenue account. An interim dividend at the rate of £5 per cent. per annum, free of income-tax, for the six months ending June 30th, 1902, amounting to £2,486, was paid by the directors on November 1st, 1902. The balance to net revenue (£5,3 5 17s. 2d.) is to be appropriated as follows:—£5 per cent. per annum on the ordinary shares, £5,096; balance carried forward, £219 14s. 7d. The total present capacity of the generating plant at the works is 1,675 kw. The plant and machinery have been maintained in a high state of efficiency out of revenue. The following table will show the rate at which the company's business has progressed:—

| | No. of consumers. | No. of lamps wired. |
|---|---|---|
| On December 31st .. 1894 .. | 38 .. | 2,150 |
| „ .. 1895 .. | 83 .. | 4,800 |
| „ .. 1896 .. | 154 .. | 8,700 |
| „ .. 1897 .. | 201 .. | 12,299 |
| „ .. 1898 .. | 244 .. | 16,190 |
| „ .. 1899 .. | 346 .. | 25,710 |
| „ .. 1900 .. | 420 .. | 31,695 |
| „ .. 1901 .. | 502 .. | 42,764 |
| „ .. 1902 .. | 608 .. | 61,454 |

and since December 31st, 1902, the number of lamps added and applied for is 3,888, making a grand total of connections and applications of the equivalent of 65,342 8-c.p. lamps. In this total is included the equivalent of 640 h.p. of electric motors. The directors, after giving the matter much consideration, have decided as from July 1st, 1903, to discontinue the charge to consumers for rent of meters used for registering current supplied for lighting purposes, except in the case of a consumer whose account for any quarter shall amount to less than 5s., when the account will be increased to 5s. in lieu of meter rent.

### Woking Electric Supply Co.

AT the annual meeting of this company, held at Woking on 7th inst., a very bright outlook was presented to the shareholders, whose previous prospects in regard to the concern had been anything but rosy. The chairman (Mr. John Ashby) in moving the adoption of the report, congratulated the shareholders on the satisfactory position of the company. At the previous meeting, he said, he explained that the directors were unable to recommend a dividend because they had been working with machinery which was, to some extent, obsolete, and with mains that were not as perfect as they ought to have been. But he foreshadowed that so soon as they got their new machinery into working order and their business on a proper footing, the results would be very different, and the anticipations he then held out had been more than fulfilled. The revenue in 1901 was £4,466, but last year it increased to £6,276. They had added 126 new consumers, and the number of lamps on circuit (in the equivalent of 8 c.p.) had increased from 15,090 to 19,566 on December 31st, and were now nearly 20,500. Although it often happened that with an increase of business there was a large increase in expenses, that was not the case with that company. Not only had they not increased, but they had gone down, being only £3,581, as against £3,867 in the previous year. This they attributed to their improved machinery and their better mains, to the use of fewer transformer stations, and to the great care exercised by their manager and engineer, Mr. J. T. McLean. After placing £250 to the depreciation account, which now stood at £2,120, and paying interest on the debentures and loans, they had a net profit of £1,677 12s. 9d. The directors recommended that two years' interest, amounting to about £1,000, be paid on the preference shares, and that the balance of £675 9s. 4d. be carried forward to the credit of this year's profit and loss account. The directors considered it would be better for all concerned if they paid no dividend this year on the ordinary shares, and he pointed out that up to the present the directors were doing their work without remuneration, their ambition being to place the business on a thoroughly sound and satisfactory footing before asking for payment. They proposed to put the sum of £4,194 19s. 3d., which included loss on the business to December 31st, 1901, and other expenses, to the credit of a "goodwill" account, which they felt justified in establishing, now that the concern was placed on a profit-earning basis. With regard to the prospects of the company, their revenue for the first quarter this year had been £2,371, compared with £1,604 for the same period of 1902. Their customers were still increasing, and they had just made arrangements with the London and South-Western Railway Co. to light the Woking station with electricity, the railway company entering into a contract to take not less than 70,000 units a year. As to the price of the current, the chairman said it had always been the object of the directors, while safeguarding the interests of the shareholders, to reduce the price of the current supplied to their customers, and they had decided that on and after October 1st they would charge only 6d. per unit, when accounts were paid within 14 days of delivery, 6½d. if not, instead of the present 13s. 4d. for the first 20 units and 7d. per unit afterwards. They had, during the past year, the chairman continued, increased their plant up to 375 kw., but they were now going to give an order for a new 400 kw. engine and dynamo. The directors also proposed to raise additional capital as required, and were open to receive applications for 6 per cent. cumulative preference shares and 4½ per cent. debentures. The chairman then moved the adoption of the directors' report and the payment of a dividend for the years 1901 and 1902 on the 6 per cent. preference shares.

The motion was adopted.

## Windsor Electrical Installation Co.

The directors' report for 1903 shows that the company's business continues satisfactory. During the year 2,549 8-c.p. lamps were added, bringing the total to 25,238 at the end of the year 1902, of which 2,164 represent the motor power.

The capital expenditure during the year amounted to £2,917 13s., bringing the total up to £62,231 11s. 1d.; the principal expenditure being on mains, an additional cable having been laid to supply the increased demand for electricity at Eton. The next highest item of expenditure was for new meters, but the larger amount of expenditure under this head is always a matter for congratulation, as it denotes the increasing number of customers. The net profit for the year, after providing for interest on borrowed capital, is £4,895 17s. 3d., and it is gratifying to note that with the exception of the sum of £446 3s. 11d. from the installation department, the whole of the profit was derived from the supply of electricity in Windsor and Eton. The small profit on the installation department is accounted for by the fact that the directors have continued their policy of carrying out this class of work at a small percentage, in order to benefit the lighting department by obtaining new customers. The total amount of profit available for distribution is £4,969 18s. 1d., and out of this the directors recommend that the sum of £830 10s. be added to the depreciation, renewal, and reserve fund, bringing this fund to the substantial total of £7,250, and the shareholders will be asked to vote the usual sum of £350 to the directors. An interim dividend of 2½ per cent. was paid by the directors during the year, and they now recommend the declaration of a further dividend at the rate of 5½ per cent. less income-tax, making a total dividend for the year of 8 per cent. The rapid increase in the demand for electricity makes it absolutely necessary to supplement the generating capacity of the works. It has not, however, been considered to be in the best interests of the company to extend the present station, and instead of erecting new works in another part of the district, the directors decided to promote a company to take over the provisional order for Slough and Datchet, and an arrangement was come to with the Slough and Datchet Co. for supplying the Windsor Co. with the additional current required upon conditions which the directors consider should be to their mutual advantage. It will be seen from the balance sheet that 10,000 of the Slough and Datchet Co.'s shares have been taken up by this company.

## Perth Electric Tramways (W.A.) Co.

The report for 1902 states that the net profit is £20,591, compared with £21,697 for the 18 months ended December 31st, 1901. The receipts for the current year are higher than for the year 1902, the total to the end of March, 1903, amounting to £14,667, while the figures for the same period in the year 1902 amounted to £13,102, and this notwithstanding the fact that traffic was lost during the early part of the year owing to the insufficient supply of cars. After debiting interest on debenture stock and other charges, the accounts show a credit balance of £11,404. From this amount the interest on the preference shares to December 31st, 1901, has been paid, leaving an available balance carried forward of £9,908. As the traffic continues to increase, more rolling stock becomes necessary, and the directors have made arrangements to purchase nine additional cars, with a carrying capacity nearly double those which are now in use. The prospects of extensions and the additions to the rolling stock in consequence of the corresponding expansion of the traffic, make it necessary for the board to consider the question of raising further capital to meet the expenditure in connection therewith. It is proposed that the shareholders be asked to sanction an increase of borrowing powers from £200,000 to £250,000.

## Buenos Ayres and Belgrano Electric Tramways Co.

Mr. J. Morris presided last week at this company's meeting at River Plate House, E.C., and said that as the result of the year's working the directors were able to pay a dividend of 6 per cent. upon both classes of preference shares, besides 7½ per cent., being the balance of the arrears on the "B" preference shares, leaving a very respectable surplus to be carried forward, and thus bringing the ordinary shares into line for participation in dividends in respect of the profits of the current year. They had also placed £5,000 to the credit of renewals fund, thereby increasing that fund to £11,000. There was a slight increase in the general traffic expenses as compared with last year. This was explained by the fact that there was an increase of 240,435 in the miles run; but although the mileage was increased by 8·3 per cent., the increased traffic expenses were only 2·8 per cent. With regard to the power expenses, as the shareholders were aware the company's power was supplied by contract extending over a considerable period, and the price varied according to the cost of coal. During the last two years the price of coal had been constantly varying, but during last year it had come back to something like its normal rate, and the directors hoped that that would continue during the current year. Notwithstanding the increased mileage, however, they had succeeded in making a reduction in the cost of current as compared with the previous year of £1,438. If coal continued at the same rate this year they hoped to effect a further saving. Last year they had to set aside £2,500 to meet the cases of compensation which were put forward, but not adjudicated upon, and of this sum a balance of £897 was left, which would amply cover any cases still unsettled. It would be noticed that the amount spent on compensation during the year was only £275. The gold premium was always a disturbing element. This year, fortunately, it remained at about 127, which was its lowest point, under the Conversion Law. He then read the report of the manager as to the outlook. The growth of the country had been absolutely phenomenal in the past, and he thought they might look forward to fair progress in the future. During the first three months of this year the gross traffics had been increased by £3,845, the net increase being £3,460. A large proportion of the gross increase was due to the difference in the gold premium. Mr. J. B. Concanon seconded the motion, and the report was adopted.

## Calcutta Tramways Co.

The meeting of this company was held at Worcester House, E.C., on 7th inst., Mr. E. C. Morgan presiding.

The Chairman, in moving the adoption of the report, said that for the further outlay which would no doubt be needed for extending and consolidating the system, the directors determined to create an additional amount of capital to the extent of £350,000, bringing up the total authorised capital of the company to £700,000. Of this new capital it was determined to issue to existing shareholders £175,000 at par. The proposals of the directors were submitted to the shareholders and approved by them, and on May 27th a circular was issued offering the 35,000 new shares to the existing shareholders. Of these shares 32,268 were taken up by the shareholders, 2,732 not being applied for. 35,000 shares remain unissued, and these will not be issued until the directors are satisfied that the position of the company can be improved by further expenditure. From the capital raised £12,430 remains unexpended, to which must be added the final payment on the new shares made on January 1st, £70,870, or a total available capital of £83 300; so that the company at the present time is provided with ample funds to deal with possible extensions. The total receipts on revenue account were £88,538, or an increase over last year of £16,367. The expenditure amounted to £56,917, or an increase of £2,345. Regarding the general condition and prospects of the undertaking, when they met about a year ago they had just commenced running by electricity, and the report gave the actual dates on which each line was opened until November 20th, when the engineer's certificate was given and the entire system worked by electricity. The results obtained from the electric traction have been most consistent; each line as it was opened added its quota to the receipts, and since the entire system has been running the takings have been well maintained at about the rate marked in November last. The jump in receipts upon the change from horse-traction to electricity was immediate, for the reason that they at once increased the accommodation by substituting a car for a pair of horses; but the further growth had been retarded by the fact that they were running all the motor-cars they immediately had available, almost to the full extent of their capacity, before complete electrical working took place, and had difficulty in maintaining as full a service when the horses were finally dispensed with, and when the motors were needed for use on every line. Further motors were now being supplied, and would be in operation very shortly; and a fuller service at certain periods of the day would have the effect of sensibly adding to the receipts. They also expected to be able to work more efficiently, in a very short time, by the opening of their new sheds on the north and south of the town. This would not only save much useless mileage, but would also enable them to get to work without the harassing delays now caused by getting the cars to their starting point before the commencement of the work. This would enable them to get more effective mileage out of the cars, whilst economising in expenditure. They might, therefore, reasonably look for a gradual expansion in their takings, as there was no lack of demand for riding facilities. They had had many applications for extensions, great and small, from the public. The electrical work was subjected to a very severe test during the Coronation festivities in January last, and in carrying nearly 500,000 passengers during the week no difficulty or interruption was experienced. As they had had to spend a very large sum of money to effect this salutary change, he summarised the advantages which had been obtained. Firstly, they had got a system by which they could meet the requirements of the public in a manner both convenient and economical to their customers; secondly, they had not only been able to increase their takings, but also to reduce expenditure; and, thirdly, they had vastly added to the assets of the company by acquiring everywhere freehold land in place of the leased premises which they formerly had, which would, as the leases fell in, or were disposed of, materially decrease their outgoings. If they had spent money boldly, they had got value for it, and had placed the undertaking upon a thoroughly sound basis. Under all these circumstances, the directors thought they might rely in future upon making an *ad interim* distribution of profits.

The report was adopted.

The Chairman moved that a dividend at the rate of 4 per cent. per annum on the old shares, and 1s. per share on the new shares be declared. The motion was unanimously agreed to.

The meeting accorded a vote of thanks to the staff in Calcutta, and voted the sum of £1,000 and best thanks to Mr. E. C. Morgan (the chairman) for the great and constant attention which he had given to the affairs of the company during a most critical period, and for the skill with which he had conducted the negotiations for the new concession and the conversion of the system to electric traction, whereby the affairs of the company had been placed on a sound basis and its prosperity restored and assured.

## Barcelona Tramways Co.

The meeting of this company held last week at Winchester House, was presided over by Mr. J. B. Concanon, who said that the available balance amounted to £33,010, from which had to be deducted debenture interest and sinking fund on the first and interest on the second debentures, £10,360; interest on loans, £90 odd; and the preference dividend, £5,000; making a total of £15,451. They had placed £5,000 to the credit of renewal fund, and proposed to pay a dividend of 5 per cent. on the ordinary shares absorbing £10,000, leaving a balance of £2,558 to be carried forward. The receipts for the past year, as compared with 1901, showed an increase of £18,420, while the working expenses had increased from £70,035 to £80,038, or a net increase of £10,355. That increase was due mainly to the fact that they ran 230,000 more miles, partly in

consequence of the little line which they opened and which runs out to the north of Barcelona called Bona Nova, and partly to the fact that they had a less number of days of strike in 1902 than in 1901. The total expenses, including taxes, had fallen from 66·40 —the ratio of expenses to receipts—to 64·70 this year. The receipts per mile, notwithstanding the very large additional mileage run, had improved from 7⅞d. to 8¼d. while the expenses had only increased from 5¼d. to 5½d. per mile run. He must prepare them for some probable decrease for the remainder of the year in the gross receipts. That was due to the fact that they found that the ½d. fares adopted on some of the principal sections, although remunerative, meant the carrying of an enormous number of passengers, also a very large tax upon the machinery; and the cars were running short and overcrowded, and there was a great amount of tear and wear. After very careful consideration, and a visit of a deputation of the board to Barcelona, they came to the conclusion that they should, for the moment at all events, try the experiment of suspending these ½d. fares. The result had rather surprised them all. They found that not only did they not carry the same number of people, but that, as a matter of fact, the 1d. sections—the resuming of the 1d. fares—did not attract half the number of people carried by the ½d. fares. However, though the forecast showed a possible decrease of traffic, the economy in working would more than meet the loss in traffic, if such a thing did come. They had placed during the year the remaining £51,900 of 4½ per cent. redeemable debenture stock, which now brought up the total 4½ per cent. stock to £200,000, which was the maximum limit.

The resolution was carried unanimously.

## Automatic Telephone Co. (1903).

The statutory meeting of this company was held on Thursday last week at Cannon Street Hotel, Mr. M. Margowski presiding.

The Chairman said that reconstruction have been more successful than had been anticipated. All their creditors would be paid in full after the holidays, and all claims be satisfied; they would then have a clean sheet. He anticipated that the company would be in a position before 12 months were out to declare a dividend. The company was now an industrial undertaking.

A discussion arose respecting the proposed election of two directors, in the course of which the Chairman said he had 500,000 shareholders in favour of the election, and if an adjournment was insisted upon he should demand a poll, an announcement which, according to the *Financial News*, caused some of the dissatisfied shareholders to quit the meeting.

The directors were afterwards elected.

## Indo-European Telegraph Co.

The directors' report for 1902 reads as follows:—

It has been decided, after several postponements, to open the International Telegraph Conference in London on May 26th next. The company's foreign concessions have all been extended up to the end of 1924, and the company is in communication with H.M. Postmaster-General with a view to an extension of its arrangement for special land wires in this country, and submarine cable wires from Lowestoft to the German coast. The tariff reductions announced in last year's report have adversely affected the company's revenue to a considerable extent, especially the Indian reduction, from 4s. to 2s. 6d per word. The lines of the company continue to work efficiently, and Wheatstone working, now introduced over the entire system from London to Teheran, gives complete satisfaction. Under its extended concessions, the company is liable for higher "paid-outs" to the Governments concerned. and as some doubt has arisen as to the incidence of these higher "paid-outs" under the Cis-Indian Joint Purse (of which the company is a member), it has been agreed to refer the matter to arbitration. The directors propose to introduce a retirement scheme for the officers and general staff of the company, to enable members of the staff, no longer able to perform their duties, to retire from the service. The company's revenue from all sources for 1902 amounted to £134,305 4s. 1d., as compared with £158,041 8s. 3d. for 1901, showing a decrease of £18,736 19s. 1d. The expenses were: On commercial and general account, £41,017 11s. 5d.; on maintenance account, £23,394 8s. 5d.; total, £64,351 19s. 10d., as against £63,859 10s. 6d. for 1901, an increase of £492 9s. 4d. Deducting the above expenses of £64,351 19s. 10d. from the total revenue of £134,305 4s. 1d., a balance remains of £69,953 4s. 3d., from which income-tax paid, £5,143 15s. 7d., has to be deducted. To this the amount brought from the year 1901, £14,897 16s. 1d., has been added, making a total of £79,707 4s. 9d. From this sum has to be deducted the interim dividend of £10,625, leaving an available balance of £69,082 4s. 9d. The directors now propose to set aside £15,000 to form a fund for the equalisation of dividends, to transfer £5,000 to a retirement fund, and to declare a dividend for the six months ending December 31st, 1902, of 17s. 6d. per share, making, with the dividend already paid, 6 per cent., and a bonus of 20s. per share, both free of income-tax, making in all 10 per cent. for the year, and carrying forward £17,207 4s. 9d. to the credit of 1903.

## Lymington Electric Light and Power Co.

The annual meeting of this company was held last week, Mr. Keppel Pulteney presiding. The directors' report recommended the payment of a dividend at the rate of 4 per cent. for the year, which would absorb £155, and the writing off £100 of the preliminary expenses, leaving a balance of £253 to be carried forward. The chairman said the year had been marked by substantial progress. The increase in gross receipts was over £360, while the increase in expenditure was only £200.

Dr. Hill seconded, and the motion was carried.

**Stock Exchange Notice.**—The Committee appointed Wednesday, April 15th, as special settling day in Type-writing Telegraph Corporation, Ltd. 71,000 ordinary shares of £1 each, fully paid. Nos. 1 to 23,562, and 23,663 to 71,100.

**Cuba Submarine Telegraph Co.**—Dividend at the rate of 5 per cent. per annum, and bonus of 4s. per share on the ordinary shares for the half-year ended December 31st.

**Oriental Telephone and Electric Co.**—The directors recommend a dividend of 3½ per cent. (making a total of 6 per cent. for the year 1902).

## STOCKS AND SHARES.

Wednesday Evening.

Markets usually take some few days to recover from the effects of the Easter holidays, and the present year forms no exception to the general rule. Investment business, as a whole, is very quiet, the prospects of cheaper money in the near future being somewhat forgotten in the Yankee collapse of the immediate present. While Consols maintain a much steadier attitude, their firmness has so far had little influence over other markets. The variable weather during the Easter vacation has made itself felt once more in the traffic receipts of the pleasure lines, and although the figures are fairly good, there can be little doubt that a less inclement Easter Monday would have made much difference to several of the companies.

A general consensus of opinion accords to the London United Tramways the chief feature of the past 10 days. The Preference shares at 12, and the Debenture stock at 107 show no quotable change, but, in view of the success attendant upon the Hampton Court extension, it is not likely that shareholders will want to sell at the present time, so that any new demand for the securities will probably advance the prices. To stand for half an hour on the Bank Holiday at Hammersmith Broadway provided much food for reflection upon the foresight and enterprise which has brought the scheme to such success, not to mention other thoughts upon the elemental parts of human nature which a struggling mob suggests. British Columbia Electric Preferred Ordinary stock has risen to 97½ upon the Canadian boom, which in some way is supposed to benefit the company. British Electric Tractions are 13⅞ and 12¼ for the Ordinary and Preference shares respectively, and again a fair amount of business is doing in the "B" Preference shares of the Buenos Ayres and Belgrano Electric Tramway, the price being 5½. Metropolitan Electric Deferred are down to 5s. middle, a small buyer having been easily supplied. It may be mentioned that North Metropolitan Trams are in quiet demand at 3¼, an impression being current that the shareholders may have yet another offer made to them for joining the later undertaking.

Electric Lighting shares offer few changes, and trade in this section continues unimportant. City of London Ordinary are a pretty good market at 10⅜, at which price they can be bought. Westminsters and St. James's are also hard, and the remark applies with equal fitness to all the best Supply shares. Kensington and Knightsbridge shares are 11 to 11½, the explosion in Brompton last Monday being regarded with equanimity. Brush Ordinary shares change hands at a sovereign, and a good many proprietors are converting their holdings into British Electric Traction shares.

In the Telegraph department National Telephone Preferred and Deferred monopolise all the attention, and the price of the former is all but par, while the Deferred is better at 78½. No change has occurred in the shares or Debenture stocks. Telegraph descriptions proper are inclined to recover again, and the Anglo-American group gamely withstood the slight shock produced by the Wall Street shake-out after the recent pronouncement against the Northern Securities "merger." Eastern Extensions remain dullish, and it is possible to buy the shares cheaper than the middle price of the official quotation. Globe Telegraph and Trust are in much the same condition.

Home railway stocks manage to keep up a semblance of activity, and in several of the trade lines there is a fair amount doing. The electrical securities, however, are rather neglected. City and South London fails to recover its recent decline, and the traffic for last week came as a disappointment. Central Londons, also with a decreased take, are without change, but Great Northern and City Preferred have firmed up to 8½. Districts at 40 and Metropolitan Consolidated at 88 call for no comment. Waterloo and City keeps about a point below par. East London Consolidated can be picked up at 6¼ or thereabouts, and those whose fancy leads them to "long shots" might do worse than buy some of this stock for locking-up purposes. The new stock of the London, Tilbury and Southend, with 90 per cent. paid up, commands 20 points premium.

Babcock & Wilcox are a little better on the declaration of an 8 per cent. dividend for the past half year, with 2 per cent. bonus. Anglo-Argentine Tramway shares at 4½ are unaffected by the issue of the report, which points out that the present ordinary shares have become 5 per cent. cumulative preference as from last New Year's Day.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1900. | 1901. | 1902. | Closing Quotations April 7th. | Closing Quotations April 15th. | Business done week ended April 16th, 1903. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 67,100 | African Direct Telegraph, 4 % Debs. | 100 | .. | .. | .. | 97 —101 | 97 —101 | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | .. | .. | .. | 2½— 3½ | 2½— 3½ | .. | .. |
| 119,700£ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | .. | .. | .. | 70 — 80 | 70 — 80 | .. | .. |
| 788,840 | Anglo-American Telegraph | Stock | 3½% | 61s. | 60/6 | 49 — 52 | 49 — 52 | 50½ | .. |
| 3,105,580 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 6 % | 90 — 92 | 90 — 92 | 91½ | 90½ |
| 3,105,580 | Do. do. do. Deferred | Stock | 5s. % | 2s. | 1/- | 8½ — 9½ | 8½ — 9½ | 9 | 8¾ |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 5 % | 5 % | .. | 4½ — 4¾ | 4½ — 4¾ | .. | .. |
| 13,333,300$ | Commercial Cable | $100 | 8 % | 8 % | .. | 160 —170 | 160 —170 | .. | .. |
| 1,841,209 | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | .. | .. | .. | 89 — 92 xd | 89 — 92 | 90 | 89½ |
| 16,000 | Cuba Telegraph | 10 | 4½% | 4 % | .. | 6½— 7½ | 6½— 7½ | 6¾ | .. |
| 6,000 | Do. 10 % Pref. | 10 | .. | .. | .. | 13½— 14½ | 13½— 14½ | .. | .. |
| 12,981 | Direct Spanish Telegraph | 5 | 4 % | 4 % | 4 % | 2½— 3½ xd | 2½— 3½ | .. | .. |
| 6,000 | do. do. 10 % Cum. Pref. | 5 | .. | .. | .. | 7 — 8 | 7 — 8 | .. | .. |
| 60,710£ | Direct United States Cable | 20 | 3½% | 3½% | .. | 9 — 10 xd | 9 — 10 | 9¾ | 9⅛ |
| 92,800£ | Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —102 | 98 —102 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | .. | 117 —122 | 116 —121 | 118½ | 117 |
| 1,955,565 | Do. 8½ % Pref. Stock | 100 | .. | .. | .. | 84 — 87 | 84 — 87 | 84 | .. |
| 1,534,645 | Do. 4 % Mort. Deb. Stock Red. | Stock | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 800,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | .. | 10½— 11½ | 11½— 12½ | 11⅛ | 10⅞ |
| 220,000£ | Do. 4 % Deb. Stock | Stock | .. | .. | .. | 105 —108 | 105 —105 | .. | .. |
| 800,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 200,000£ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | .. | .. | .. | 101 —104 % | 101 —104 % | .. | .. |
| 180,227 | Globe Telegraph and Trust | 10 | 5½% | 5½% | .. | 8½— 9 | 8½— 9 | 8⅝ | .. |
| 180,042 | Do. do. 6 % Pref. | 10 | .. | .. | .. | 12 — 13 | 12 — 13 | 12½ | 12 |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 15 % | 15 % | .. | 25 — 27 | 25 — 27 | 25⅛ | .. |
| 66,300£ | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10 % | 10% | 37 — 41 | 37 — 41 | .. | .. |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. | 100 | .. | .. | .. | 100 —104 | 100 —104 | .. | .. |
| 72,680 | Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680 | 1 | 2½% | 2½% | .. | ¾— ⅞ | ¾— ⅞ | .. | .. |
| 86,492 | Do. do. 5 % Pref., Nos. 1 to 86,492 | 1 | .. | .. | .. | ¾— 1 | ¾— 1 | .. | .. |
| 1,988,333 | National Telephone, Pref. Stock | 100 | 5 % | 5 % | 6 % | 98 —100 | 98 —100 | 99¼ | 99 |
| 1,966,667 | Do. do. Def. Stock | 100 | .. | .. | 4½% | 76 — 78 | 77 — 79 | 78 | 77 |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 13 — 14 | 13 — 14 | .. | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 12 — 13 | 12 — 13 | .. | .. |
| 250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5½— 5⅝ | 5½— 5⅝ | .. | .. |
| 2,000,000£ | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 97 — 99 | 97 — 99 | 99 | .. |
| 600,000 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 102 —104 | 102 —104 | .. | .. |
| 171,804 | Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid | 1 | 6 % | 6 % | .. | ¾— 1 | ¾— 1 | .. | .. |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 11,889 | Reuter's | 8 | 5 % | 5 % | .. | 6½— 7½ | 6½— 7½ | 6⅝ | .. |
| 8,808 | Submarine Cables Trust | Cert. | .. | .. | .. | 105 —115 | 102 —112 xd | 105 | .. |
| 58,000 | United River Plate Telephone | 5 | 7 % | 7 % | .. | 5½— 5⅝ | 5½— 5⅝ | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | .. | .. | .. | 4¾— 5¼ | 4¾— 5¼ | .. | .. |
| 172,947£ | Do. do. 6 % Debs. | Stock | .. | .. | .. | 105 —108 | 105 —108 | 107½ | .. |
| 15,609 | West African Telegraph, Shares | 10 | .. | .. | .. | 3 — 4 | 3 — 4 | .. | .. |
| 30,008 | West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008 | 2½ | .. | .. | .. | 0 — ¼ | 0 — ¼ | .. | .. |
| 150,000£ | Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel. | 100 | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 267,980 | Western Telegraph, Ltd., Nos. 1 to 207,980 | 10 | 7 % | 7 % | .. | 11 — 12 xd | 11 — 12 | 11⅛ | .. |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 400,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 88,821 | West India and Panama Telegraph | 10 | 1% | .. | .. | ⅛— ¼ | ⅛— ¼ | ⅛ | .. |
| 84,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | .. | .. | .. | 6½— 6¾ | 6½— 6¾ | .. | .. |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | .. | .. | .. | 4 — 5 | 4 — 5 | .. | .. |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,600 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | British Aluminium 7 % Cum. Pref. | 10 | .. | .. | .. | 3 — 4 | 3 — 4 | 3⅜ | 3⅛ |
| 800,000£ | Do. do. 5% 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 75 — 80 | 75 — 80 | .. | .. |
| 100,000 | British Electric Traction | 10 | 9 % | 9 % | .. | 13½— 14 | 13½— 14 | 13⅛ | 13⅛ |
| 100,000 | Do. do. 6 % Cum. Pref. | 10 | .. | .. | .. | 12 — 12½ | 12 — 12½ | 12⅛ | 12⅛ |
| 600,000£ | Do. do. 5 % Perpetual Debenture Stock | Stock | .. | .. | .. | 122 —125 xd | 122 —125 xd | 124½ | 123½ |
| 100,000 | British Insulated and Helsby Cables | 5 | 15 % | 10 % | 10 % | 8 — 8½ xd | 7¾— 8 | .. | .. |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | .. | .. | .. | 5⅝— 6¼ | 5⅝— 6¼ | .. | .. |
| 50,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | .. | .. | .. | 103 —107 | 103 —107 | .. | .. |
| 50,000 | ¶Browett, Lindley & Co., Ord. | £1 | 8 % | Nil | .. | 12/6 to 13/6 | 12/6 to 13/6 | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. | £1 | 6 % | 6 % | .. | 16/6 to 17s. | 16/6 to 17s. | .. | .. |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 | 2 | 5 % | Nil | Nil | 2— 1½ | 2— 1½ | 1½ | 1 |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 6 % | 3 % | 6 % | 1½— 2 xd | 1½— 2 | 1½ | 1⅜ |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock | Stock | .. | .. | .. | 99 —102 | 99 —102 | 101½ | 100½ |
| 125,000£ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | .. | .. | .. | 89 — 94 | 89 — 94 | .. | .. |
| 35,000 | Callender's Cable Construction shares | 5 | 15 % | 20 % | .. | 13 — 14 | 13 — 14 | 13⅜ | 13⅜ |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 5½— 6 | 5⅜— 6 | 5⅜ | .. |
| 90,000£ | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 108 —112 xd | 108 —112 | .. | .. |
| 1,860,014 | Central London Railway, Ord. Stock | Stock | .. | 4 % | 4 % | 104 —107 | 104 —107 | 106 | 105½ |
| 494,998 | Do. do. 4 % Pref. Stock | Stock | .. | 4 % | 4 % | 103 —106 | 103 —106 | 103½ | .. |
| 494,998 | Do. do. Def. do. | Stock | .. | 4 % | 4 % | 106 —109 | 107 —110 | .. | .. |
| 1,330,000 | City and South London Railway | Stock | 1½% | 2 % | 3½% | 74 — 76 | 75⅛— 76⅛ | 74½ | 73½ |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 3 | 8 % | 7½% | .. | 2½— 2⅔ | 2½— 2⅔ | .. | .. |
| 100,000£ | Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red. | .. | .. | .. | .. | 102 —106 | 102 —106 | .. | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261 | 5 | 2½% | Nil | .. | 0 — ¼ | 0 — ¼ | .. | .. |
| 17,139 | Do. do. "A" shares, 01—017,139 | 5 | 2½% | Nil | .. | 1½— 2½ | 1½— 2½ | .. | .. |
| 344,023£ | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 73 — 77 | 73 — 77 | .. | .. |
| 100,000£ | Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd. | 100 | .. | .. | .. | 75 — 80 xd | 75 — 80 | .. | .. |
| 112,100 | Electric Construction, 1 to 112,100 | 2 | 6 % | 6 % | .. | 1½— 2 | 1½— 2 | 1⅝ | 1½ |
| 31,390 | Do. do. 7 % Cum. Pref., 1 to 31,390 | 2 | .. | .. | .. | 2½— 3 | 2½— 3 | .. | .. |
| 82,500£ | Do. do. 4 % Perp. 1st Mort. Deb. Stock | Stock | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | 5 % | .. | 10 — 10½ | 10 — 10½ | .. | .. |
| 200,000 | Do. do. 4 % Mort. Deb. | Stock | .. | .. | .. | 99 —102 xd | 99 —102 | .. | .. |
| 35,000 | Henley's (W. T.) Telegraph Works, Ord. | 5 | 20 % | 20 % | 20 % | 15 — 16 | 15 — 16 | .. | .. |
| 35,000 | Do. do. 4½ % Pref. | 5 | 4½% | .. | .. | 5 — 5½ | 5 — 5½ | .. | .. |
| 48,050 | Do. do. 4½ Mort. Deb. Stock | Stock | .. | .. | .. | 107 —111 | 107 —111 | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | 10 % | .. | 18½— 19½ | 18½— 19½ | 19 | .. |
| 800,000£ | Do. do. do. 4 % 1st Mort. Deb. | 100 | .. | .. | .. | 100 —103 | 100 —103 | 100½ | .. |
| 37,500 | †Liverpool Overhead Railway, Ord. | 10 | 3½% | 1½% | 1½% | 5⅝— 5⅞ | 5⅞— 6 | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | .. | .. | .. | 10½— 11 | 10½— 11 | .. | .. |
| 7,500 | Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500 | 10 | .. | .. | .. | 14½— 15½ | 14½— 15½ | .. | .. |
| 87,350 | Telegraph Construction and Maintenance | 12 | 17½% | 20 % | 20 % | 36 — 39 | 36 — 39 | 37½ | 36 |
| 150,000£ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 540,000£ | Waterloo & City Railway, Ord. Stock | 100 | 3 % | 3 % | 3½% | 97 —100 | 97 —100 | 98½ | .. |

† Quotations on Liverpool Stock Exchange.
§ From Bradford Share List.
‡ Unless otherwise stated all shares are fully paid.
¶ From Manchester Share List.

## LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, nil to 6d.
National Electric Free Wiring, ½—¾.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14—15.
Do. do. Pref (£10 pd.), 9½—10½.

**Bank rate of discount 4 per cent. (October 2nd, 1902).**

## SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

| Present issue. | NAME. | Stock or Share. | Dividends for the last three years. 1900. | 1901. | 1902. | Closing Quotations April 7th. | Closing Quotations April 15th. | Business done week ended April 15th, 1903. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| | | ‡ | | | | | | | |
| 100,000 | Blackheath and Greenwich Dist. Electric Light, Ord. | 1 | .. | .. | .. | ¾— 1 | ¾— 1 | .. | .. |
| 100,000 | Do. 4½% 1st Deb. Stock, Prov. Certs. | 100 | .. | .. | .. | 118 —121 xd | 118 —121 | .. | .. |
| 20,000 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 | 5 | 6 % | 8 % | 8 % | 10¼— 10⅝ | 10¼— 10⅝ | 10¼ | .. |
| 20,000 | Do. do. 7 % Cum. Pref. | 5 | .. | .. | .. | 10 — 10⅜ | 10 — 10⅜ | .. | .. |
| 50,000 | Charing Cross and Strand Electricity Supply | 5 | 9 % | 10 % | 10 % | 9 — 9⅛ | 9 — 9⅛ | .92 | 9.5/16 |
| 70,000 | Do. do. do. 4½% Cum. Pref. | 5 | .. | .. | .. | 5⅛— 5⅜ | 5⅛— 5⅜ | 5.5/16 | .. |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. | 5 | .. | .. | .. | 4⅞— 5⅛ | 4⅞— 5⅛ | 5¼ | 5 |
| 250,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 104 —106 | 105 —107 | .. | .. |
| 44,436 | *Chelsea Electricity Supply, Ord. | 5 | 5½% | 4 % | 4½% | 6 — 6¼ xd | 6 — 6¼ | .. | .. |
| 150,000£ | Do. do. % Deb. Stock Red. | Stock | .. | .. | .. | 109 —112 | 109 —112 | 110⅜ | 110¼ |
| 70,595 | City of London Electric Lighting, Ord. 40,001—110,595 | 10 | 0 % | 5 % | 5 % | 10 — 11 | 10½— 11 | 10¾ | 10⅝ |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | .. | .. | 13¼— 14½ | 13⅜— 14½ | .. | .. |
| 400,000£ | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid | .. | .. | .. | .. | 122 —127 | 122 —127 | .. | .. |
| 800,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid | 100 | .. | .. | .. | 103 —106 | 103 —106 | .. | .. |
| 40,000 | County of London & Brush Prov. Electric Lighting, Ord. 1—40,000 | 10 | 4 % | 4 % | 4 % | 8 — 9 xd | 8 — 9 | 8⅞ | .. |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | .. | .. | 12 — 13 xd | 12 — 13 | .. | .. |
| 400,000£ | Do. do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red | .. | .. | .. | .. | 109 —112 | 109 —112 | 110¾ | 110½ |
| 50,000 | Edmundson's Electric Corporation, Ord. Shares | 5 | 7 % | 7 % | .. | 6½— 6⅞ | 6⅞— 7⅛ | .. | .. |
| 30,000 | Do. do. 6 % Cum. Pref. | .. | .. | .. | .. | 6¾— 6⅞ | 6¾— 6⅞ | 6.7/8 | 6.7/8 |
| 140,000 | Do. do. 4½% 1st Mort. Deb. Stock | 100 | .. | .. | .. | 107 —110 | 107 —110 | .. | .. |
| 21,000 | Kensington and Knightsbridge Electric, Ord. | 5 | 12 % | 10 % | 10 % | 10½— 11½ | 10½— 11½ | 11½ | .. |
| 90,000 | Do. do. do. 4 % Debenture Stock | Stock | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 110,000 | London Electric Supply Corporation, Limited, Ord. | 3 | .. | .. | .. | 2⅛— 2⅜ | 2⅛— 2⅜ | 2⅛ | 2.7/8 |
| 49,840 | Do. do. do. 6 % Pref. | 5 | .. | .. | .. | 5⅜— 6 | 5⅜— 6 | 5⅝ | .. |
| 250,000£ | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | .. | .. | .. | 100 —103 | 100 —103 | 102½ | .. |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 | 10 | 6 % | 6¼% | 7½% | 17½— 18½ | 17½— 18½ | 18½ | 17.1/8 |
| 220,000£ | Do. do. 4½% 1st Mort. Deb. Stock | .. | .. | .. | .. | 109 —114 | 110 —115 | .. | .. |
| 250,000£ | Do. do. 3½% Mort. Deb. Stock Red | Stock | .. | .. | .. | 98 —101 | 98 —101 | .. | .. |
| 10,852 | Notting Hill Electric Lighting | 10 | 7 % | 6 % | 6 % | 14 — 15 | 14 — 15 | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. | 5 | 14⅓% | 14⅓% | 14⅓% | 15½— 16½ | 15 — 16 | 16¼ | 15⅝ |
| 20,000 | Do. do. do. 7 % Pref. 20,081 to 40,080 | 5 | 7 % | 7 % | .. | 8¾— 9¼ | 8¾— 9¼ | .. | .. |
| 150,000£ | Do. do. do. 3½% Deb. Stock Red | 100 | .. | .. | .. | 98 —101 | 98 —101 | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. | 5 | .. | .. | 2½% | 3 — 3⅛ | 3 — 3⅛ | .. | .. |
| 50,000£ | Do. do. 4% Deb. | 100 | .. | .. | .. | 88 — 93 | 88 — 93 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. | 5 | .. | .. | 1¾% | 3½— 4 | 3½— 4 | 3⅞ | 3.1/8 |
| 30,000 | Urban Electric Supply, Ord. | 5 | .. | .. | .. | 4⅜— 5⅛ xd | 4⅜— 5⅛ | .. | .. |
| 30,000 | Do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 4⅜— 5⅛ xd | 4⅜— 5⅛ | .. | .. |
| 110,000 | Westminster Electric Supply, Ord. | 5 | 10½% | 10½% | 12 % | 12 — 13 | 12 — 13 | 12⅜ | .. |
| 28,141 | Do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 6¼— 6⅝ | 6¼— 6⅝ | .. | .. |

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

## MARKET QUOTATIONS, Wednesday, April 15th.

| CHEMICALS, &c. | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|
| *a* Acid, Hydrochloric | per cwt. | 5/- | .. |
| *a* ,, Nitric | per cwt. | 22/- | .. |
| *a* ,, Oxalic | per cwt. | 32/- | .. |
| *a* ,, Sulphuric | per cwt. | 5/6 | .. |
| *a* Ammoniac, Sal | per cwt. | 42/- | .. |
| *a* Ammonia, Muriate (crystal) | per ton | £33 10 | .. |
| *a* ,, | per ton | £30 | .. |
| *a* Bleaching powder | per ton | £4 10 | .. |
| *a* Bisulphide of Carbon | per ton | £15 | .. |
| *a* Borax | per ton | £13 | .. |
| *a* Benzole (90 %) | per gal. | 7/- | .. |
| *a* ,, (50/90 %) | per gal. | 5/6 | .. |
| *a* Copper Sulphate | per ton | £23 15 | .. |
| *a* Lead, Nitrate | per ton | £24 | .. |
| *a* ,, White Sugar | per ton | £31 | .. |
| *a* ,, Peroxide | per ton | £27 10 | .. |
| *a* Methylated Spirit | per gal. | 2/6 | .. |
| *a* Naphtha, Solvent (90% at 160° C). | per gal. | 5/6 | .. |
| *a* Potash, Bichromate, in casks | per lb. | 3d. | .. |
| *a* ,, Caustic (75/80%) | per ton | £24 | .. |
| *a* ,, Bisulphate | per ton | £35 | .. |
| *a* Shellac | per cwt. | 119/- | .. |
| *a* Sulphate of Magnesia | per ton | £4 10 | .. |
| *a* Sulphur, Sublimed Flowers | per ton | £6 5 | .. |
| *a* ,, Recovered | per ton | £5 10 | .. |
| *a* ,, Lump | per ton | £5 | .. |
| *a* Soda, Caustic (white 70 %) | per ton | £10 15 | .. |
| *a* ,, Crystals | per ton | £3 | .. |
| *a* ,, Bichromate, casks | per lb. | 2½d. | .. |
| **METALS, &c.** | | | |
| *b* Aluminium Ingots, in ton lots | per ton | £148 | .. |
| *b* ,, Wire, in ton lots | per ton | £224 | .. |
| *b* ,, Sheet, in ton lots | per ton | £191 | .. |
| *p* Babbitt's metal ingots | per ton | £43 to £145 | .. |
| *c* Brass (rolled metal 2" to 12") basis | per lb. | 7½d. | .. |
| *c* ,, Tube (brazed) | per lb. | 9½d. | .. |
| *c* ,, ,, (solid drawn) | per lb. | 8½d. | .. |
| *c* ,, Wire, basis | per lb. | 7⅝d. | .. |
| *c* Copper Tubes (brazed) | per lb. | 10d. | .. |
| *c* ,, ,, (solid drawn) | per lb. | 10½d. | .. |
| *g* Copper Bars (best selected | per ton | £78 | .. |

| METALS, &c. (*continued*). | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|
| *g* Copper Sheet | per ton | £78 | .. |
| *g* ,, Rod | per ton | £78 | .. |
| *e* ,, (Electrolytic) Bars | per ton | £78 | .. |
| *e* ,, ,, Sheets | per ton | £84 | .. |
| *e* ,, ,, Rod | per ton | £74 10 | .. |
| *e* ,, ,, H.C. Wire | per lb. | 9d. | .. |
| *f* Ebonite Rod | per lb. | 3/- | .. |
| *f* ,, Sheet | per lb. | 5/- | .. |
| *g* German Silver Wire | per lb. | 1/6 | .. |
| *h* Gutta-percha fine | per lb. | 8/- | .. |
| *h* India-rubber, Para fine | per lb. | 3/10 to 3/10½ | .. |
| *i* Iron, Charcoal Sheets | per ton | £18 | .. |
| *i* ,, Pig (Cleveland warrants) | per ton | 50/- | 6d. dec. |
| *i* ,, Forgings, according to size | per ton | From £11 | .. |
| *i* ,, Scrap, heavy | per ton | 47/6 to 50/- | .. |
| *i* ,, Wire, galvanised No. 8 | per ton | £9 15 | .. |
| *g* Lead, English Ingot | per ton | £12 17 6 | 2/6 dec. |
| *g* ,, ,, Sheet | per ton | £14 10 | .. |
| *m* Manganin Wire No. 28 | per lb. | 8/- | .. |
| *g* Mercury | per bot. | £8 12 6 | .. |
| *d* Mica (in original cases) small | per lb. | 8d. to 9d. | .. |
| *d* ,, ,, medium | per lb. | 1/9 to 2/9 | .. |
| *d* ,, ,, large | per lb. | 3/3 to 7/8 | .. |
| *p* Phosphor Bronze, plain castings | per lb. | 1/- to 1/2½ | .. |
| *p* ,, rolled bars & rods | per lb. | 1/1 to 1/4 | .. |
| *p* ,, ,, strip & sheet | per lb. | From 1/2 | .. |
| *o* Platinum | per oz. | £4 | .. |
| *p* Silicium Bronze Wire | per lb. | 10d. to 1/- | .. |
| *i* Stee., Magnet, acc'd'g to desc'p'n | per ton | £58 | .. |
| *i* ,, in bars | | £15 to £40 | .. |
| *g* Tin, Block | per ton | £136 to £137 | £1 dec. |
| *g* ,, Foil | per lb. | 1/6½ | .. |
| *n* ,, Wire, Nos. 1 to 16 | per lb. | 1/9½ | .. |
| *p* White Anti-friction Metals— | | | |
| "White Ant" brand | per ton | £42 to £65 | .. |
| *j* Yarns, 2/10s Grey Cotton, on sp'ls | per lb. | 7½d. | .. |
| *j* ,, 6 lea. Flax | per lb. | 5⅝d. | .. |
| *j* ,, 3 ply 10 lbs. Russian | per lb. | 4½d. | .. |
| *j* ,, 10 lbs. Russian, single | per lb. | 4½d. | .. |
| *j* ,, 180 lbs. Jute rove | per ton | £11 | .. |
| *k* Zinc, Sh't (Vieille Montagne bnd.) | per ton | £26 15 | .. |

Quotations supplied by:—*a* Messrs. G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Messrs. Thos. Bolton & Sons., Ltd.; *d* Messrs. F. Wiggins & Sons.; *e* Messrs. Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* Messrs. James & Shakspeare; *h* Messrs. Edward Todd & Co.; *i* Messrs. Bolling and Lowe; *j* Messrs. ; *k* Messrs. Morris Ashby, Ltd.; *m* Messrs. W. T. Glover & Co., Ltd.; *n* Messrs. P. Ormiston & Sons; *o* Messrs. Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

| Locality. | Week ending | Receipts for the week. £ | Receipts for the week. £* | Total to date. £ | Total to date. £* | Miles open. | * |
|---|---|---|---|---|---|---|---|
| Aberdeen | Apr. 11 | 934 | +165 | 43,172 | +11,221 | — | — |
| Birmingham | ,, 11 | 5,034 | +148 | — | — | — | — |
| Blackburn | ,, 10 | 1,058 | +449 | 1,945 | + 195 | 12½ | +1½ |
| Blackpool and Fleetwood | ,, 11 | 582 | +128 | 3,350 | — 3 | 7½ | — |
| Bolton | ,, 12 | 2,390 | +928 | 3,624 | + 975 | — | — |
| Bristol | ,, 10 | 4,712 | +730 | — | — | 28 | — |
| Burnley | ,, 11 | 1,028 | +414 | — | — | — | — |
| **British Elec. Trac. Co.:—** | | | | | | | |
| Barnsley District | ,, 3 | 175 | — | 2,125 | — | — | — |
| Devonport | ,, 3 | 432 | + 17 | 5,124 | — 17 | 5 | — |
| Dudley—Stourbridge | ,, 3 | 781 | —353 | 9,234 | + 469 | 18¾ | — |
| Gateshead | ,, 3 | 856 | +101 | 10,714 | + 2,208 | 10½ | + ½ |
| Gravesend—Northfleet | ,, 3 | 192 | — | 2,358 | — | 3½ | — |
| Greenock—Pt. Glasgow | ,, 3 | 496 | — 44 | 5,524 | + 470 | 7½ | — |
| Hartlepool | ,, 3 | 231 | —119 | 2,887 | + 404 | 6½ | +2 |
| Kidderminster | ,, 3 | 105 | — 86 | 1,317 | + 2 | 4½ | — |
| Merthyr | ,, 3 | 193 | —111 | 2,500 | — 344 | 8 | — |
| Middleton | ,, 3 | 262 | —142 | 3,052 | — 235 | 8½ | — |
| Oldham—Ashton | ,, 3 | 537 | —100 | 6,884 | + 550 | 8 | — |
| Peterborough | ,, 3 | 138 | — | 1,296 | — | — | — |

* Compared with the corresponding period of 1902.

| Locality. | Week ending | Receipts for the week. £ | Receipts for the week. £* | Total to date. £ | Total to date. £* | Miles open. | * |
|---|---|---|---|---|---|---|---|
| B.E.T. Co. (*continued*)— | | | | | | | |
| Poole | Apr. 3 | 245 | —107 | 3,072 | + 440 | 8½ | — |
| Potteries | ,, 3 | 1,565 | — 71 | 19,897 | + 1,552 | 28½ | — |
| Rothesay | ,, 3 | 55 | — 8 | 553 | + 141 | — | — |
| Southport | ,, 3 | 252 | —102 | 2,882 | + 905 | 5½ | — |
| South Staffordshire | ,, 3 | 805 | —190 | 9,350 | — 4.9 | 21½ | —½ |
| Swansea | ,, 3 | 446 | —120 | 5,798 | + 263 | 5½ | — |
| Taunton | ,, 3 | 78 | — 14 | 667 | — 70 | 1½ | +½ |
| Tynemouth | ,, 3 | 227 | —132 | 2,758 | + 154 | 3½ | — |
| Weston-super-Mare | ,, 1 | 34 | — | 340 | — | 2½ | +½ |
| Wolverhampton Dist | ,, 3 | 370 | + 99 | 4,646 | + 2,491 | 10½ | +8 |
| Yorkshire Woollen Dist. | ,, 3 | 206 | — | 1,066 | — | 6 | — |
| Dover | ,, 11 | 248 | + 70 | 2,620 | + 8 | 8 | — |
| Dublin | ,, 10 | 4,560 | +315 | 61,567 | + 3,231 | 46 | — |
| East Ham | ,, 11 | 728 | + 370 | 1,138 | + 376 | 5 | +½ |
| Glasgow | ,, 11 | 13,207 | +2272 | 553,866 | +23,300 | 53 | +12½ |
| Liverpool | ,, 4 | 9,685 | — 156 | 129,898 | + 5,984 | — | — |
| Newcastle | ,, 11 | 3,332 | +1366 | — | — | 17 | — |
| Sunderland | Mar. 29 | 1,061 | — 62 | — | — | 12 | — |
| Central London Railway | Apr. 11 | 36,614 | — 206 | 104,478 | + 5,277 | 6½ | — |
| City and S. London Ry. | ,, 12 | 2,719 | — 218 | 47,754 | + 3,000 | 6 | +½ |
| Liverpool Overhead Ry. | ,, 12 | 1,685 | +178 | 22,764 | + 1,768 | 6½ | — |

# INSTITUTION OF ELECTRICAL ENGINEERS.

## Birmingham Local Section.

On Wednesday, March 25th, a large number of members visited the Metropolitan Carriage Works, where they had an opportunity of inspecting the 250-B.H.P. gas engines which are employed for driving two-phase alternators in parallel. These engines are of the Westinghouse single-acting vertical type, having three cylinders.

There are three sets of engines and generators, with flexible couplings between the alternators and engines, two sets being enough to take the afternoon load. It was stated that the machines were running well in parallel, that a very great economy had been effected by replacing the old steam plant, which had been scattered about the works, by electric driving, and that the gas engines had proved to be satisfactory and economical.

The motors, some of them rated at 40 H.P., are all of the induction type, and are mostly used for driving shop shafting. It was explained that the reason of selecting two-phase rather than three-phase machines was in order that the lighting of the works, which cover a large area, might also be effected. In the Birmingham district there are three such Westinghouse installations, the other two being at Messrs. Cadbury's works and the Birmingham Small Arms Factory, all of them using units of 250 B.H.P., with producer gas.

## Power Transmission by Gas.

At the meeting in the evening at the University, Prof. Burstall read a paper on the above subject, Mr. Henry Lea, the chairman, being in the chair.

The efficiency of a gas transmission scheme which had been worked out for a distance of 80 miles, came out at 90 per cent., taking the mechanical efficiency of the compressor at ·8, which is certainly a remarkable result.

On the assumption that there would be no leakage, and not taking into consideration the considerable cost for jointing, &c., the Professor showed that with a pipe 4 ft. diameter, and assuming 70 cb. ft. of producer gas per B.H.P., it was possible to transmit 56,700 B.H.P., the velocity of the gas being 30 ft. per second. The Professor stated that nearly a century ago the late Sir William Siemens proposed to transmit power over comparatively long distances by means of gas under pressure, but nothing was done to bring the scheme to a commercial issue. However, not many years after, compressed air was employed for the transmission of power in Paris on a very large scale.

The development of electrical power distribution schemes in this country has caused attention to be again given to the possibilities of using gas for the purpose of power transmission. Prof. Burstall went on to say that, granted a suitable cheap gas can be manufactured from common coal, there are certain advantages in a gas transmission which are entirely lacking in the transmission of energy in any other form; the loss of power in a gas main was roughly stated to vary as the square of the velocity with which the gas moves, the actual coefficient of friction being very low.

With producer gas containing from 35 per cent. to 45 per cent. of incombustible matter, to pass a given amount of power through a main, either the velocity must be increased or the gas must be transmitted under a pressure very much in excess of that used in lighting gas mains.

It will be obvious that the producer station should be placed as near the coal supply as possible, as otherwise there would be a charge for carriage, and the size of the installation should be not less than 5,000 H.P., but preferably from 20,000 to 50,000 H.P. The question then arises as to whether the gas should be used for generating electrical energy or be transmitted itself through pipes?

According to Prof. Burstall, a great advantage arising from the transmission of gas was due to the fact that it might be reasonably expected to obtain a very much better load factor, due to the demand for heating applications, over that required for power and lighting. Prof. Burstall assumed that, of the total gas produced, 60 per cent. would be used for heating purposes, and that the load factor for this portion would be 50 per cent., while allowing a load factor for the gas employed for power at only 25 per cent., the total load factor in this case would be 38 per cent. at the gas producing station.

The gas would be distributed at pressures suitable for the distance to which it was to be transmitted, the tabulated result being that, at the moderate velocity of 30 ft. per second, a transmission distance of 80 miles could be obtained with a pressure of 44 lbs. per sq. in., and an efficiency of 90 per cent. A main 4 ft. in diameter would, under these conditions, transmit nearly 57,000 H.P., a figure which, he ventured to say, was quite as high as could be obtained by an electrical distribution. The gas would be led to sub-stations, and the mains would distribute it to customers under a low pressure. At these stations would be placed large gas engines for the production of two or three-phase current at a high pressure of from 5,000 to 15,000 volts, according to the size of the locality covered.

The current required for lighting and traction would be obtained through converters at suitable spots. Manufacturers could be supplied with polyphase current at a reduced voltage, or continuous current. Prof. Burstall went on to say that the use of large gas engines for the production of polyphase current seemed to be viewed with some suspicion. It might, however, be taken as quite certain that gas engines of 1,000 H.P. could be obtained which would run with such regularity as to enable the alternators to be run in parallel, and he knew of one large station of 10,000 H.P. which is about to be effected with gas-driven alternators of 1,500 H.P. each; he did not doubt that in a few years engines of 3,000 to 4,000 H.P. would be readily obtainable.

In referring to a suitable joint for such pipes, he said that careful experiment had shown that under a pressure of 100 lbs. per square inch the leakage need not exceed 4 per cent. per mile, and he was of opinion that for such an application as he had indicated the leakage could be kept down as low as $\frac{1}{10}$ of 1 per cent. per mile. He did not suppose that the cost of the pipes would be as much as for electric mains laid underground and transmitting the same power. The Professor further referred to the reduction of the smoke nuisance, and of the immense sums spent in cleaning due to this cause, and the economy arising from the more perfect combustion of fuel; the use of gaseous fuel would result in a saving of from one-third to half of our total coal consumption.

## Discussion.

The Chairman (Mr. Henry Lea) mentioned that it was unsafe to prophesy; he quoted from the prospectus of the Birmingham compressed air scheme in 1883:—"Compressed air is the only general mode of transmitting power, the only one that is always and in every case possible, no matter how great the distance nor how the power is to be distributed and applied." Dealing with Dowson gas, he said that anthracite coal cost in Birmingham 24s. 6d. a ton; common engine slack could be purchased in the same city for 4s. a ton; the ratio of prices being six to one. If an engine with Dowson gas would give 1 H.P.-hour for, say, 1¼ lbs. of anthracite, they were no better off as far as coal consumption went than if 7½ lbs. of common slack were burnt under a steam boiler to produce 1 H.P. Prof. Burstall had not told them at what price he proposed to supply the Mond gas, but it had been stated that the price proposed was to be 2d. per 1,000 cb. ft. Worked out on the basis that every cubic feet contained 140 thermal units, and that a ton of ordinary engine slack contained 11,000 to 12,000 thermal units, they would find that to get the same heat from the Mond gas as they would get from the combustion of coal, they would have to pay at the rate of 36s. a ton for the engine slack; therefore Mond gas would not effect a saving in the cost of fuel, unless by the use of the gas they could very much reduce the quantity necessary for carrying on the operation.

Sir Oliver Lodge spoke of the expensiveness of producing gas for heating purposes. He noticed that Prof. Burstall did not lay stress upon that which Sir William Siemens laid stress on in the seventies—viz., the value of the coke. He (Sir Oliver) had been interested in this subject of transmission of power by gas for many years—indeed, ever since the early seventies, when Sir William Siemens made his communication—and he was delighted to find it taken up by his colleague, Prof. Burstall. Sir William Siemens pointed out—he supposed correctly—that when gas was made for lighting purposes—gas full of heavy hydro-carbon—one must be satisfied with an imperfect and rather rubbishy kind of coke; whereas, if one did not care for the luminous power, but only for the calorific power, good coke could be produced which would almost pay for the cost of the coal. He knew Prof. Burstall's reply would be that he was speaking of producer gas—Dowson and Mond gas—which, of course, would turn the carbon into gaseous fuel also; but he would ask Prof. Burstall if it was hopeless to produce more ordinary coal gas of much greater heating power than Mond gas for the purpose of long-distance transmission. It was true that the producer gas was much cheaper, but then it was much less valuable; it had only, he believed, about a third of the heating power that coal gas had, and therefore it was very bulky for transmission over long distances. If it were to be consumed on the spot—if the factory that produced it could also consume it, then it was quite well; the fact that it was bulky did not matter. But if it were to be conveyed 133 miles or any such distance as that, then he should say that the interest on the mains necessary for transmitting so much bulky material would swallow up the difference in the price of the gas. With regard to the pressure and speed in mains, as given in the figures put before them by Prof. Burstall, he did not know whether he understood them correctly. If they took what was evidently the most important line in the figure, where the pressure was half an atmosphere in excess of the ordinary, or 7 lbs. to the square inch, and where, if pipes were used to transmit it at a speed of 20 ft. a second, under that pressure gas could be sent 133 miles, he did not quite see what limit the distance was. That pressure was able to give a sufficient gradient to transmit 133 miles at 20 ft. a second, or 59 miles at 33 ft. a second, so that it was clear a moderate velocity was best, because he supposed that at higher speeds one began to get eddies. Under 20 ft. a second the results were remarkable. The amount that could be transmitted seemed to be 19,000 H.P., with an efficiency of 96 per cent. That, he took it, was with a 4-ft. main. (Prof. Burstall: Yes.) There could be a great many 4-ft. mains, and an enormous amount of gas could thus be conveyed to a town. He had long thought the proper method of supplying a town with heat was not to bring coal in order to dirty the air and to have the ashes to carry away again, not to choke up the railway with coal trucks, but to bring that which travelled much more easily, some form of fluid—electricity, perhaps gas. They should convert the coal into gas at the pit's mouth and then let it flow over any reasonable distance, and by means of a pumping station start it thence again on its journey, instead of trying too much initial pressure, which it was obvious was not economical. In such a town as Birmingham and many towns in the Midlands, the coalfields were within reach.

Mr. Bell (British Westinghouse Co.), referring to the leakage, said the leakage of the joints varied as the circumference. It seemed to him it would be very much more expensive to make a 48-in. main that would be tight than such a main as the Professor had spoken of. Of course, there was no difficulty about it, the only question was whether it was within commercial possibility? As to large gas engines, in a comparatively short time no doubt 2,000-H.P. and 3,000-H.P. engines would be as common as were such steam engines now. Deductions from Prof. Burstall's figures showed

a leakage of producer gas over a distance of 133 miles of rather more than 30 per cent., and he (Mr. Bell) was not quite sure that with such a leakage the city atmosphere would not be worse than it now was with the smoke. The carrying of pipes through land which had been undermined also appeared to him to be a very great difficulty.

Mr. A. M. Taylor pointed out that the poor load factor of about 12 per cent. for municipal electric lighting and power stations, would be rather unremunerative to a supply company; on the other hand, the demand for power by factories, &c., might bring up the load factor to 35 per cent. It seems reasonable, therefore, to expect that a load factor of 25 per cent. as an all-round figure might be realised. Mr. Taylor showed by curves that with a 12 per cent. load factor, the cost to the consumer on account of energy wasted in the cable is 0·02d. per unit, taking every unit at the main generating station as costing 0·7d. per unit; also that the cost of maintenance taken at 2 per cent. on capital cost of cable and trench work amounts to 0·039d. per unit delivered, and, lastly, that interest and sinking fund taken at 7½ per cent. on capital cost of cables (including spares), and trench work, amounts to no less than 0·148d. per unit. For a load factor of 25 per cent. the curves showed these costs to be reduced respectively to 0·018d., 0·020d., 0·075d., showing the importance of keeping the load factor up to at least 25 per cent. Mr. Taylor concluded his remarks by saying that if Prof. Burstall had treated the cost of the gas main in the same way as he had treated the electric, they would have been in a position to know the increased charge per cubic foot of gas delivered on account of such main, and so to more properly consider the whole question.

Prof. Threlfall said that it was wonderful how difficult it was in a meeting of any Society to get anywhere near the truth as to the commercial aspect of the subject. The fact was that those who had opinions which were worth having did not find it worth while to publish them for nothing. Having made many hundreds of millions of feet of producer gas, he knew how very difficult it was to say in any particular case what the cost of manufacture would be. The question of the flow of gas in pipes was a very difficult one. The theoretical distribution of velocity of a fluid in a pipe, as shown by the studies of D'Arcy, the French engineer, was that the middle flow was greater than that round the sides of the pipe. It had been usual to assume that such was invariably the case with gas. He had investigated the flow in a great many pipes, and in all the experiments he had made it had never happened that the flow of gas took place even approximately according to the law laid down by D'Arcy for the flow of water. He had found, what was much more important, that when once the velocity across a certain gas pipe had been determined, then you might determine the velocity of gas in wide limits without altering the direction.

Mr. C. A. Smith, addressing himself to Prof. Burstall's claim that the cost of gas transmission would compare very favourably with that of electrical work with underground cables, said the Professor talked of 80 miles transmission. He (Mr. Smith) thought Prof. Burstall would agree that overhead wires would be employed in such a scheme if the Board of Trade would permit it, and the comparison in that case would rather be with high voltage for overhead wires (of from 40 to 60,000 volts) such as was used in America. He had written to some of the companies interested in the manufacture of gas engines, and he heard from the English representatives of the John Cockerill Co. that they would guarantee a 5,000-h.p. horizontal engine, four-cylinder tandem, two cranks, to run with alternators in parallel with a 40-ton fly-wheel. That, however, was a Continental make, and the company had not any actually running yet. Sir Oliver Lodge had arrived at the conclusion that it was best to use moderate velocities for gas transmission, but he (Mr. Smith) had come to quite an opposite opinion. Had Sir Oliver noticed that the efficiency of transmission was the same at velocities of 20, 30 and 40 ft. per second, although, of course, the length of transmission was different, and had he noticed the tremendous increase in the b.h.p. transmitted by the 4-ft. main with the high velocities? He ventured to say that for transmission over 20 miles it would pay to use velocities as high as 80 ft. per second, because the extra cost of compressors would be less than the extra interest on the main. He could not quite follow Prof. Threlfall's reasoning and objections. He understood that the results had been worked out from the formulæ published by Unwin, obtained from experiments on the Paris air mains. Surely Mond gas would adhere to these laws, in which every allowance was made for the eddy currents and turbulent motion. He himself had been considering two alternative schemes, viz., generating electricity by means of a producer gas station on the coal field, and transmitting it to sub-stations, and transmitting the Mond gas to sub-stations to be used for gas engines there. Granted the same load factor in each case, he greatly favoured the former scheme, because it enabled good use to be made of the heat of the exhaust gases from the engines, and because of the greater economy of large gas engines. But if a large part of the producer gas was to be used for heating purposes, the conditions were altered.

Dr. D. K. Morris said many of them, if not all, had been surprised to see that there was really a rival to the now widely used electric power transmission. In this country electric power transmission had a poor chance, owing partly to the climatic conditions and partly to the Board of Trade—owing, in fact, to the impracticability of using overhead wires. But it was interesting to see what overhead wires were capable of doing. He had taken a basis of 10,000 h.p., 20,000 volts three-phase supply, 80 per cent. efficiency, and 20 miles, and he found the amount of copper required came out, at £80 per ton, to £138 per mile. That was a mere trifle. Unit power factor had been assumed, and on that account the figure should perhaps be increased to something like £160. The cost of erection of the line might bring up the amount to about £300. Again, the low efficiency taken might give bad regulation. But still, those were small figures, and the amount of copper used was very small compared with the amount of metal required by the pipe lines referred to by Prof. Burstall. He took it, the cost of a pipe line would be very great as compared with the lowest price of an electric line. It seemed to him that gas power transmission would be rather a suitable thing in the case of corporations which were able to raise money at a low rate, or, generally speaking, when the amount required to be transmitted was on a fairly large scale, and it was also possible not to regard too much the interest on capital. Though Prof. Burstall had not raised the question of cost, he thought they must bring that immediately before them to see how they stood in this matter.

Prof. Burstall, in reply, said he knew quite well the commercial aspect would be raised, and he was very glad indeed to think he did keep clear of it. The chairman had put his finger on a very important point with regard to the price of gas being equivalent to that of slack at a very high cost. Of course, comparing the amount of heat derivable in the form of lighting gas with coal, it is very small, but it paid to use a small engine and lighting gas, rather than a large boiler and coal. You could afford to pay a very large figure for your heat if supplied in convenient form. He should say the price of producer gas would be considerably less than the amount quoted by the chairman, if supplied on anything like a large scale. Sir Oliver Lodge had in a very happy way raised the question which was constantly being raised, as to giving a gas of a higher calorific power. Everybody said, "Why do you make producer gas, more than half of it being incombustible?" Of course you could make gas from coal very much cheaper than the existing lighting gas, and you could make water gas, but in both cases the cost was too much for the people to be able to afford to use it in competition with other means of transmission. He recently had to do with an immense transmission 300 miles across what was practically a desert, and the question was whether overhead wires or a main would be best. The main carried it off. What everybody seemed to have forgotten was that the gas main had a high load factor. Whether it was so in the case of the electric main they did not know, and you could afford to spend money on a main when you had a load factor of 40 per cent. Mr. Bell had inquired with regard to $p\,v^{1\cdot3}$; that was the actual figure he got off the Paris air compressors. No doubt there would be some water present as steam, but probably the figure would be found approximately correct. Of course, the 30 per cent. of gas being lost in the length assumed, one would get ·4 per cent., but he did not anticipate more than ·1 as a maximum value, and that would reduce the 30 per cent. to just 7½. In America the pipe lines ran for hundreds of miles, and there was no trouble whatever about the leak. It was not a serious matter to have a leak in a producer gas main in an open country, and the mains would run over open country and not in towns at this pressure. The question of the sinking of strata due to coal being taken away, was, of course, very serious, but that also was capable of solution; it would only be a matter of putting riveted steel mains in, and making proper arrangements for holding them up at intervals. Mr. Taylor's tables were extremely interesting, but if they took the generation of electric power at ·4 of a penny, they could do very much better by using gas. The figures as to distribution did not affect his (Prof. Burstall's) general problem at all. What he wanted was to get the power from the pit-mouth to the place where he wanted to generate, and he would rather do that by gas mains than by electric mains. Mr. Smith had referred to the cost of overhead lines as compared with underground cables. He did not care to enter into that matter, which should be readily worked out. Large gas engines alluded to by the same speaker, had not come into use to anything like the extent that was anticipated at one time, and the reason was that unfortunately in this country the large gas-driven central station had been a failure. But he did not think that would occur again; at any rate, there were plenty on the Continent of immense size. Dr. Morris's remarks with regard to the cost of the line were very interesting, but the matter was outside the range of the paper.

## MODERN TENDENCIES IN THE UTILISATION OF POWER.*

By J. J. FLATHER.

(*Continued from page* 632.)

While it may be impracticable to reheat the air in certain cases, yet there are many situations where a study of means to overcome the losses referred to would result in marked economies.

The greater adaptability of compressed air to various purposes causes its use to increase along with that of the electric motor, for it has a different field of usefulness, independent of power transmission; at the same time when the requirements are properly observed in its production and use, its economy as a motive power in special cases compares favourably with other systems. With a better knowledge of the principles involved we may expect much better results than have yet been attained.

But compressed air possesses so many advantages, that, however inefficient it may be as a motive power, its application to shop processes will be continually extended as its usefulness becomes better known.

Mention has been made of the use of hydraulic motors as a factor in the sub-division of power, but these are being used to such a limited extent for this purpose that we shall not consider them at the present time.

* Address of the chairman of Section D, Engineering and Mechanical Science, and Vice-President of the American Association for the Advancement of Science. Read at the Washington meeting, December 29th, 1902.

There is, however, a growing field of usefulness for hydraulic power in manufacturing operations which is peculiar to this agent alone, namely, its use in forging and similar work. Where hydraulic power exists for this purpose it is also generally used for a variety of purposes which could be accomplished just as well, and often more economically, by steam or compressed air; but in forging operations where heavy pressures are required hydraulic power is infinitely better than either.

The compressibility of air is an objection in many lines of work, and it is now well recognised that the effect of a hammer blow is oftentimes merely local. As Mr. H. F. J. Porter has so ably shown in the *Transactions* of the *A S M E.*, Vol. xvii., the pressure applied in forging a body of iron or steel should be sufficient in amount and of such a character as to penetrate to the centre and cause flowing throughout the mass; as this flowing of the metal requires a certain amount of time the pressure should be maintained for a corresponding period.

Hydraulic pressure, instead of a hammer, should therefore be used to work it into shape. Under its action the forging is slowly acted upon and the pressure is distributed evenly throughout the mass, whereas under the high velocity of impact of the hammer the metal does not have time to flow, and thus internal strains are set up in the mass, which may cause serious results, especially with certain steels which have not the property of welding.

Besides the fundamental defects incident to the method, it is very troublesome to use a hammer in certain lines of work, on account of mechanical difficulties of manipulation.

The quality of the steel is very much improved by the processes of hydraulic forging, and we find a marked tendency to substitute this method in a wide variety of work in which presses are employed varying in capacity from 20 tons to 14,000 tons.

We are all familiar with the fact that the magnificent 125-ton hammer made by the Bethlehem Steel Co. lies idle, while the work for which it was intended is done by a 14,000-ton hydraulic press operated by an engine of 15,000 H.P.; it may not be so generally known, however, that all forgings except small pieces are done on hydraulic presses, and that the largest hammer in actual operation is one of 6 tons capacity in the blacksmith shop.

The pressure used in these works is 7,000 lbs. per sq. in., but the present tendency indicates the use of a so-called low-pressure transmission service under a pressure of 400 or 500 lbs., with an intensifier at the press which raises the pressure to 2,500, 5,000, 7,000 lbs., or whatever may be required.

In this case the lifting and lowering of the ram of the press is effected by low-pressure water, so that the cylinder always remains filled, and the high pressure is only brought to bear the moment the dies come in contact with the pieces to be forged. The intensifier is built in multiple, which permits of a variable force to suit the work to be done; its action and control are extremely simple, and results are produced which show a marked increase in speed and a decided economy in operation. Some of the recent German hydraulic forging machines equipped with intensifier operate at a speed of 40 to 70 strokes per minute, on finishing, and 20 to 30 strokes per minute for the heaviest work.

The success which has attended the use of hydraulic power in forging is causing it to be applied to other and similar work to an increasing extent. In boiler works, railroad and locomotive shops, bridge works and ship-yards, it is used along with compressed air, but where heavy pressures are desired hydraulic power is greatly to be preferred; hence we find it operating machines for punching and shearing heavy plates and sectional beams, riveting machines, stationary and portable, flanging and bending machines, tube upsetting machines, wheel and crank-pin presses, lifting jacks and hoists of all kinds.

For heavy boiler work hydraulic riveting seems especially well adapted, as an intensity of pressure can be brought to bear upon the plates which is obtained by no other method.

We have already stated that compressed air as now used without reheating is not at all efficient as a source of motive power, since the combined efficiency of compressor and motor, even under favourable conditions, is not more than 50 per cent. of the available energy put into the compressor. In other cases the efficiency is as low as 20 per cent.

In the transmission of air, within reasonable limits, the loss in transmission if the pipes be tight need not be considered, for although there is a slight loss in pressure due to the frictional resistances of the pipes, yet there is a corresponding increase in volume due to drop in pressure, so that the loss is practically inappreciable.

There should be no comparison between the cost of power by compressed air and its brilliant rival, electricity, since each has its own field of usefulness, yet it may be interesting to note for our present purposes the efficiency of electric power. A modern shop generator belted from an engine will have an efficiency of about 90 per cent. when working under favourable conditions, but as the average load is ordinarily not more than two-thirds full load, and often much less, the efficiency will not usually be more than 85 per cent. Since the engine friction was added to the losses in compression, so also it should be considered here, in which case the efficiency of generation will lie between 75 and 80 per cent. With a three-wire 220-volt system, which is very suitable for ordinary shop transmission when both light and power are to be taken off the same dynamo, the loss in transmission need not be more than 5 per cent., so that the efficiency at the motor terminals will not be far from 75 per cent. With motors running under a nearly constant full load the efficiency of motor may be 90 per cent.; but with fluctuating loads this may fall to 60 per cent. at quarter load. In numerous tests made by the speaker the average load on several motors in machine shops has been only about one-third of the rated capacity of the motor. It is interesting to note that in tests made at the Baldwin locomotive works it was found that with a total motor capacity aggregating 200 H.P., a generator of only 75 KW. was sufficient to furnish the current, and ordinarily only 60 KW., or 40 per cent., was required. At the present time there are in use at these works upwards of 300 motors with a combined total capacity of 2,200 or 2,300 H.P.; whereas the generator output is only about 500 KW.

Under those conditions, where the driven machines are not greatly over-motored, we may assume a motor efficiency of 80 per cent., which may be less or greater in individual cases. The combined efficiency, then, of generator and motor working intermittently with fluctuating loads will be about 60 per cent. of the power delivered to the engine.

For greater distances than those which obtain in plants of this character the loss in transmission will be greater, and higher voltage must be employed in order to keep down the line loss. While it is possible to put in conductors sufficiently large to carry the current with any assumed loss, yet the cost of the line becomes prohibitive with low voltage.

Where cheap fuel is available it is found in most cases that electric power can be generated at the works more cheaply than it can be purchased from a central station; especially is this the case if the exhaust steam be used for heating purposes. In isolated plants the cost of transmission is very small as compared with the total cost of generation; whereas in the average central station the cost of transmission, which includes interest and depreciation on pole line, usually constitutes a large percentage of the operating cost.

In those localities where the cost of fuel is high, electric power can often be purchased more cheaply from a central station which obtains its power many miles distant and transmits it electrically to a convenient distributing centre, where it is used for power and light.

The recent development in electrical transmission is very marked, and one constantly hears of some new achievement more wonderful than anything previously accomplished. Distances have been gradually increased until it is now possible to transmit electrical energy economically and in commercial quantities up to 150 and even 200 miles.

There has been a steadily increasing tendency to raise the line voltage in such transmissions, and to-day we find in successful operation voltages as high as 40,000 and even 60,000 as compared with the 4,000 and 6,000 volts of a few years ago.

As pointed out by Mr. A. D. Adams,* so far as present practice is concerned the limit of use of high voltages must be sought beyond the transformers and outside of generating and receiving stations. As now constructed, the line is that part of the system where a final limit to the use of higher voltages will first be reached.

In order to avoid the temporary arcing and leakage between the several wires it is necessary to place the wires a considerable distance apart, which, with higher voltages, may lead to a modification in construction of pole line. The plan of substituting a series of steel towers about 90 ft. in height and 1,000 ft. apart is being seriously contemplated.†

In this case it is proposed to suspend the wires from tower to to tower and separate them about 9 ft. apart. While expensive in first cost, it is thought that the satisfactory working of the system and freedom from breakdown, with the low maintenance and depreciation charges involved, would warrant the investment.

A more serious difficulty is found in the insulator, which is generally looked upon with distrust for the higher voltages in use to-day. With a more perfect insulator there would appear to be no good reason why the present maximum voltages should not be exceeded.

The possibility of electrical transmission thus permits of the utilisation of available sources of power at great distances from the centre of distribution; but while it is interesting to know that a certain amount of power may be transmitted a given distance with a high degree of efficiency, it is more important to know whether the same amount of power could be obtained at the objective point more economically by other means.

*(To be continued.)*

## THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

THE REQUIREMENTS OF GERMAN AUTHORITIES.—PROPOSED COMBINATION OF AUSTRIAN WORKS.

THE Berlin Chamber of Commerce has apparently been inspired by interested parties to make a public complaint against the treatment meted out to electrical companies by State and municipal authorities in regard to contracts offered for competition. In the course of its annual report for 1902 the Chamber submits that these authorities are specially difficult customers, as even when comparatively unimportant goods are needed they require the presentation of tenders accompanied by comprehensive plans, schemes and estimates, which involve a large expenditure of work and money, without any compensation being granted. The result is an accentuation of competition, and one firm falls over another in endeavouring to outbid it in the matter of guarantees and offers to lease the contemplated works.

* *Eng. Mag.*, October, 1902.

† Geo. H. Lukes in *Trans. Assn. Edison Illuminating Companies*, July, 1902.

The German electrical industry is now looking out for new fields of development. One is the utilisation of blast furnace gases in modern gas engines for the operation of rotary current dynamos in connection with mining operations, and the use of electric motors for pumping and winding engines at mines. A second important step is the experiments which are being made under the auspices of the Government for solving the problem of high-speed electric railways. In these and other directions it is hoped that the period of depression will soon be succeeded by an era of prosperity.

### German Enterprises.

The report of the Union Electricity Co. for 1902 shows, as might be expected from the general condition of the industry, a further decline in prosperity. Apart from the bond issue, the company has a share capital of £1,200,000, and it was able to distribute a dividend of 10 per cent. in 1900, and 6 per cent. in 1901, whilst only 4 per cent. is proposed to be paid for 1902. The gross profits earned last year amount to £141,417, as compared with £179,100 in the previous year, and after writing off £38,150 for depreciation as against £45,930, and meeting expenses and interest charges, there remains a net profit of £49,088 as compared with £75,000 in 1901. Having thus given the general results, reference may now be made to the report, which states that the prevailing circumstances constrained the company, in conjunction with the Allgemeine Elektricitäts Gesellschaft, to take the initiative in bringing about a community of interests, and this example has already been emulated. The other companies have, however, only amalgamated their manufacturing operations and spheres of activity, but the Union Co. and the A.E.G. have consolidated the whole of their interests in order, whilst at the same time maintaining the individual external form of the companies, to concentrate their organisation, and thereby shape more effectively and economically, and also to utilise the joint relations in connection with business enterprises. During the year the Union Co. has succeeded in reducing general expenses by alterations in the organisation of the works, and in cheapening the cost of production, so that there are now available standard types of direct and alternating-current dynamos and motors to the smallest details. The report regards the adoption of the manufacture of railway motors and appliances as of special importance, as these have not hitherto been produced on a large scale in Germany. The number of workmen employed ranged from 1,350 in the spring to 1,875 at the end of the year, and the total output of dynamos and motors advanced from 126,030 H.P. in 1901 to 130,188 H.P. in 1902. After referring to the equipment supplied for various tramways, the company mentions the order received from the State Railway Administration for the introduction of electric traction on the Anhalt suburban railway, which is about 12 miles in length. This is the first full-gauge railway in Germany to be equipped on the third-rail system, and the contract also provides for the delivery of 18 coaches and 38 motor-cars of 125 H.P. each. The trial trips on the railway are to take place shortly, and the regular opening of traffic has been fixed for the month of July. Coming to the question of lighting and power transmission, the report remarks that considerable orders have been received from colliery owners, and the introduction of high-pressure centrifugal pumps promises to largely expedite the adoption of electric pumping. Expression is given to the belief that the use of large gas engines for driving dynamos has already ensured the success of electric pumping in coal mines, and it is expected that a similar impetus will be imparted in the operation of winding engines for main shafts. Similarly, the iron and steel industry is considered to be a profitable sphere of activity, especially in regard to the operation of rolling mills, and reference is made to the electric rolling mill being completed at the Bethlem-Falva Ironworks, where an ingenious system of "fly-wheel transformer" is being introduced to meet the large variation in the demand for power in such a manner that the supply can be obtained from public distributing mains. It is anticipated that the perfection of such specialities will create a considerable demand for large machines, whilst increasing orders are being received for the many accessories already introduced for iron and steel works.

The Berlin Company for Electrical Enterprises, which is an investment company mainly concerned in lighting and tramway undertakings in European and other countries, complains in its annual report for 1902 of the industrial depression and other causes which have hampered the development of these enterprises and compelled the writing down of the value of securities. As the closing months of the past year and the opening months of 1903 indicate a slight improvement in the general circumstances, it is expected that the unfavourable results of the past year will not be repeated in the future. The company has a share capital of £1,500,000 and a bond issue of £1,750,000, the latter alone absorbing £73,750 as interest for the past year. The profits obtained from participations and securities amount to £95,881, and after deducting working expenses, the interest on the bonds and sundry items, there only remains as net profit the sum of £687, which is carried forward to the next account. The passing of the dividend for 1902 is remarkable in view of the previous records, which are represented by dividends of 8½ per cent. in 1897, 10 per cent. both in 1898 and 1899, 8 per cent. in 1900, and 4 per cent. in 1901. Among the company's investments may be mentioned large holdings in the Anglo-Argentine Tramways Co., the Chilian Electric Tramway and Light Co., the British Thomson-Houston Co. and the Electricity Supply Company for Spain.

The Electric Car Construction (Busch) Co., of Hamburg, which is largely interested in the English firm of Milnes & Co., has had to suffer from the lack of sufficient orders combined with low prices during the year 1901-1902. As a consequence, the execution of contracts has been delayed in order to equalise working operations as much as possible, and the sales have, therefore, not reached the anticipated total. The year's trading has resulted in a loss of over £10,000, which is covered by absorbing the balance of profit arising from the reconstruction of the company in the previous year. The amount of the company's interest in the English firm exceeds £30,000. The latter, according to a statement made by Herr Busch at the recent general meeting, is satisfactorily employed, but is still in course of development.

The Pollak Accumulator Co., of Frankfort-on-the-Maine, which has a share capital of £100,000, terminated the year 1901 with a deficit which, on January 1st, 1902, amounted to £15,244. During the year a further loss has been incurred both in regard to the Frankfort works and the Vienna branch establishment, but after taking into consideration the refund of illegally-paid dividends, and of directors' fees, amounting to £7,232, the deficit on January 1st, 1903, only becomes increased to £15,380. The unprofitable branch at Vienna has been entirely closed.

### Undertakings in Other Countries.

The community of interests and amalgamations have no sooner been completed in Germany, than a similar scheme is reported to be in course of negotiation in Austria. It is said that the project comprises the Austrian Union Electricity Co. (a promotion of the Union Co., of Berlin), the Austrian Schuckert Co., and the branch establishment of the Siemens & Halske Co. The prospect of the creation of more intimate relations between the external off-shoots of the Siemens & Halske Co. and the Schuckert Co. has already been foreshadowed in the official communications issued by the latter two companies in connection with their scheme of amalgamation, but no mention has previously been made of the inclusion of the Austrian Union Co. in this direction. It may be that the Union Co. will form one of the Austrian works to combine for the purpose of meeting the competition of the branches representing the fusion of the Siemens and Schuckert Cos.

The reorganisation of the Alioth Electricity Co., of Arlesheim, near Basle, which was proceeded with in 1901, has apparently produced an improvement in the position of the undertaking. It was possible, by reducing the share capital from £120,000 to £60,000, by the issue of £120,000 in preference shares, and by appropriating the amount standing in the reserve fund, to extinguish the deficit of £136,000 which existed at the end of the year. This drastic scheme has so far proved effective, as the accounts for 1902 show profits which allow of the distribution of a dividend at the rate of 4 per cent. on the preference capital.

The Swedish General Electricity Co., of Vesteras, which was established with a share capital of 5,000,000 crowns, is reported to have lost one-half of its capital owing to excessive valuation of the shares for the purpose of raising a loan, and to the payment of exaggerated dividends. It is now proposed to reorganise the company by the reduction of the shares from 1,000 crowns to 500 crowns each, and by the issue of preference shares to the extent of 1,000,000 crowns.

Among other results, the following may be mentioned:—The Russian General Electricity Co., no profits as against 10 per cent. paid in 1900-1901; the Russian Helios Co., loss of 85,194 roubles as compared with a profit of 2,348 roubles in 1900-1901; Ganz and Co., dividend of 12½ per cent. for 1902 as against 12 per cent. in previous year; the Cable Works Co., of Pressburg and Vienna, 7 per cent., as in 1901.

## CARBON FILAMENT GLOW LAMPS.

Whereas recent attempts have been generally directed to replacing the carbon filaments in electrical glow lamps by other filaments of various compositions, including but small amounts of carbon or no carbon at all, G. Weissmann, in a recent article (*Journal de Physique*) attempts to show that it is by no means necessary to give up the carbon filaments hitherto in use in order to obtain higher efficiency.

The author takes exception to the comparatively high pressures which are mostly made use of. With a pressure as high as 220, or even 110 volts, it is necessary to use filaments of a relatively great resistance, *i.e.*, extremely thin and long filaments, to obtain the usual candle-powers of 5, 10, and 16 candles. Now, in making tests on these filaments, says the author, we have generally failed to allow for the fact that in practice, where the abrupt increases in temperature accompanying sudden variations of the pressure will have a most destructive effect on the filaments, the conditions are entirely different from those met with in laboratory tests, the thin filaments being especially sensitive to such variations because of their small mass.

The author states that, in the case of 110-volt 16-C.P. lamps, consuming, say, 3·5 w. per Hefner candle, or 4 w. per decimal candle, under normal conditions, an average loss of 5 per cent. of the initial candle-power will be noted after 100 hours, increasing to as much as 20 per cent. after 300 working hours. With the same lamps, this decrease in the intensity will be 25 per cent after 100 hours when the consumption of power is 2 w. per candle; 220-volt 16-C.P. lamps are found to undergo a loss of 17 per cent. after 100 working hours, with 3·5 w. per Hefner candle.

Generally speaking, for lamps of the same voltage and efficiency, the curve of variation of candle-power, with time of burning, will be the more unsatisfactory, as the nominal value of the candle-power is less. For a given pressure, but different luminosities, the curve of variation of candle-power can be maintained approximately constant only by regulating the efficiency according to the candle-power.

In order to obtain for 110 volts and 10 or 5-C.P. lamps a curve corresponding approximately with the curve of 16-candle-lamps, the

inefficiency for 10 candles has thus to be increased to 4 w., and for five candles to 5 w. per candle.

For 110 volts and 32, 50, 100 candles, on the other hand, a consumption of 3, 2, 5 and 1·2 or 2 watts per candle only will be required.

Now, the only essential difference between those lamps resides in the different thicknesses of the filaments, the existence of a relation between the diameter of the filaments and the efficiency of the lamps being thus clearly shown.

The author suggests the following explanation of this fact:—The higher the surface-temperature of the filaments, the greater will be the danger of particles being projected, this danger being the only practical limit of the intensity of incandescence. The quantity of light, however, depends only on the *mean* temperatures, the filaments radiating by their mass. Now, for a thin filament, the mean and surface temperatures are practically identical, whereas in the case of thick filaments, the internal temperature will be very much higher, the higher, in fact, as the filament is thicker. The external temperature, and accordingly the danger of destruction being therefore the same, the thicker filament will exhibit a higher efficiency, its internal temperature being higher, a fact agreeing perfectly with the experiments of Elihu Thomson and Weber. The fact above mentioned of the greater resistance these thicker filaments possess for variations of pressure, may equally play a not unimportant part.

From these results, it appears that with carbon filaments, one has so far obtained only the maximum efficiency corresponding with 110 volts, and not the absolute maximum efficiency that these filaments are capable of giving.

The economising system, designed by the author with the assistance of M. Blondel, consists in diminishing in a suitable way the voltage of the supply current at the point of consumption, lamps with thick carbon filaments being used.

By dividing up, for example, a 100-volt 100-candle filament, five 22-volt 20-candle filaments are obtained of the same efficiency as the original filament, consuming only 1·8 or 2 watts per candle, as this does. The transformation is secured by inserting a very small transformer between each group of lamps simultaneously lighted and the supply mains. An interrupter is placed in the primary circuit of the transformer, so that the latter, acting automatically with the corresponding group of lamps, will never work without load. The efficiency of the transformers is 91 or 97 per cent. respectively, according as they are arranged for 30 or 50 watts.

The company L'Economiseur Electrique has already installed in Paris several thousands of these lamps, showing a saving as high as 40 or 60 per cent. as compared with high-voltage lamps.

## POINTS IN THE DESIGN OF A POWER PLANT.

By W. H. BOOTH.

The operation of designing a power plant involves many considerations, and a considerable amount of study and calculation, if the result is to be something better than a mere heterogeneous collection of samples of mechanical engineering fortuitously gathered under one roof, and lacking in proportion, form, and fitness for the particular case in hand. The basis of design is, of course, the amount of power required, and it is necessary to provide that the maximum demand for power shall be met by every detail of the plant. To ensure that this shall be secured with a minimum of expense is one of the main objects of the designer.

An analysis of the plant which must or may be employed gives the following items of the first class:—(1) Boilers; (2) Steam engines and condensing plant; (3) Generators; (4) Accumulators.

Of the second class of apparatus there are:—(1) Feed pumps; (2) Feed heaters; (3) Water coolers; (4) Stoking machines; (5) Coal and ash conveyors.

In a third class may be placed tanks, reservoirs, wells, and other incidentals.

Commencing with the boilers, it is at once obvious that they must supply the maximum steam demand. In a traction station this demand is steady and uniform, the variations of the load being too rapid to affect the boilers, especially if these are of large water capacity.

In a lighting station there are several courses open. The boilers may be sufficient to give the maximum peak load when it comes on. If fitted with forced draught, they can be forced to their maximum output at such times. If only fitted with natural draught, this, during a fog, may be at its worst when the demand for current is greatest, and an excess of boiler power must be laid down.

If accumulators are used to get over the peak of the load, this will reduce the necessary boiler plant considerably, and the effect of accumulators will thus extend to boilers, feed heaters, pumps, and to all the items of class 2, in fact, as well as to engines. In a traction station, however, the use of accumulators will only extend its influence directly to the engines and generators, though it will indirectly affect the boilers, because it will render it more economical to work the engines, *i.e.*, at steady load instead of at widely varying loads.

If liable to be called on for sudden flushes of steam, the firing of boilers may be done with liquid fuel at the heavy points, and the output of steam may thus be instantaneously increased or diminished with ease. It may even be desirable to employ water-tube boilers of the small tube type, which hold very little water, and may be started up from cold water, and put under full steam in a few minutes.

The steam engines must be provided to take the maximum load with a very little reduction of speed. They will consume steam according to their load factor, and this will depend upon the nature of the load. The power to be supplied in a lighting station will vary according as whether accumulators are provided or not; but in a lighting station the number of engines will always be greatly in excess of the mean load requirements, unless the accumulators are very much in excess of anything yet attempted.

In a traction station a poor load factor may render it desirable to use simpler engines than are justified when the load is steady. Only when the engines are decided upon can their steam consumption be arrived at, and the boilers designed. The generators will be designed similarly to the engines, with due regard to the use of accumulators. When accumulators are employed so that the output of current is even and regular, a generator cannot be run at such an output as it will give as a maximum when there are no accumulators, for it would become overheated at the constant load. As far as possible the generator should be capable of such an output as will stop the engine; the engine ought not to be capable of burning out the generator. Accumulators serve in a lighting station to cut off the sharp peak of the maximum load, and in a traction station to reduce the load curve to a level line; they affect the engine by enabling it to be run at its constant economical load, and they reduce the whole of the plant in proportion to the economy thus secured.

Thus, the items of class 1 are all mutually inter-dependent and must first be designed, the items of class 2 being provided in accordance with the boilers decided on. The items of class 3 are to be considered separately, and depend upon local circumstances, such as the presence of a canal, a river or a sufficient area for storage, as well as upon hydro-geological conditions. By carrying through a design with and without accumulators, may be ascertained the economy of these, most certainly remembering to bring into the equation the buildings affected, and to take into account every factor.

In favour of accumulators there are to be placed a less cost of plant throughout, and a reduced cost of coal, water, oil and stores, depreciation and maintenance, while against them are the interest charges, depreciation, maintenance and general expenses of the accumulator itself, any buildings to house the accumulator being much less costly than the saving in the main buildings of the boiler house or engine room.

The design of plant thus far has not been considered in respect of types to be employed. Of engines there are the low and high speed, as well as horizontal, vertical, or combination types; there are various types of boilers to be selected from, and the question of buildings is always closely allied to that of plant. Though the working of the plant must usually be accorded first place in arranging the buildings on a given site, the erection of the plant should receive every possible thought in respect of convenience of access for delivery of heavy boilers and machinery. A heavy boiler may well be carried through an empty engine room, but this method would afford poor satisfaction when the station was at work and a new boiler had to go the same way.

It is poor economy not to provide from the start a solid road for carts and lorries to bring plant to the delivery point, and when possible the loads should be capable of of being brought under the engine room traveller.

The buildings should thus be laid out with all these points in view, so that they may receive the maximum consideration consistent with ultimate economy of working costs.

Generally the process of design must start from an assumed load curve. This can usually be approximated

from a similar existing plant. The lighting station and the traction station offer the two extreme types of load. In the lighting station there is little or no load during daylight hours, and this is easily carried by a small set of machinery or is worked from the accumulator. As darkness sets in the load comes on with great rapidity, runs up to a peak of brief duration and declines as rapidly. Unless a battery is provided to give out a large output for an hour or two there must be provided engines and boilers sufficient to give the maximum output even for only the few minutes' duration of the sharpest peak of the load curve. The plant necessary to work for only these few minutes may be quite a large fraction of the whole machinery. Yet it will remain idle except for these few minutes. These considerations, therefore, point to the use of special fuel to urge the steam production over the critical period even at much enhanced cost. Oil and other liquid fuels are specially suitable for this purpose. So also is artificial draught, while the engine plant will be minimised by wasteful rates of expansion during maximum load periods, not forgetting, however, that too wasteful engine running implies a bigger demand on the boilers. The accumulator offers itself as the best means of reducing the machinery installed, for it can be run at maximum output over the peak of the load, and it will carry the day load without running the engines, or, if a day load is run off an engine, the surplus current can be run into the battery.

A traction load is quite different. The full load soon comes on, and it continues very even for the whole day, and falls to zero quickly as the cars are shedded at night. But the load curve varies rapidly from maximum to minimum every few seconds, and the duty of a battery in such a station is to equalise these variations.

As the mean load of a small station may be, say, 20 per cent. only, it appears that the engine may be reduced to about a fourth of the maximum power of a non-battery station. Engines work so very much more economically under steady load than when running at a mean load only a fifth or a fourth of maximum, that half the fuel may be saved by using accumulators, and this will cut the boiler costs in two and all other co-ordinate expenses.

In regard to more detailed design, the foregoing being considered general or proportional, the question of arrangement comes in.

Coal can rarely be delivered at such a height that it will gravitate from the bunkers to the machine stokers. These machines are not advisable where the coal must be lifted by hand into hoppers, and if hand firing is decided upon, it will often be easy to tip the coal direct to the bunkers from carts or railway trucks. Hand-fired boilers should be allowed sufficient space in front to permit of the use of a 10-ft. rake by a man standing behind the rake, and there should be room enough behind the man for a fair heap of coal outside the bunker. Less room may serve with machine stoking, but in any case it is bad policy to reduce this space to a possible minimum, and it is not desirable to place boilers to face each other with a common floor space between, if this can be avoided. Mechanical stokers should be supplied with coal by travellers or from bunkers above. Where the bunkers are in front of the boilers, each boiler may be supplied by its own light coal conveyor delivering to the hopper. If the coal must come from the end of the house, one traveller may be arranged to tip into all the hoppers, the tipping latch being put out of action automatically as the hoppers fill up, and the speed of the conveyor being regulated so that an occasional bucket remains untipped and returns to the bunkers. If, however, the conveyor carries ashes on its return journey, the condition of the last hopper may be made to determine whether the conveyor shall rest awhile. Where bunkers of large capacity are placed sufficiently high to feed all hoppers, the conveyor will simply carry all coal from the point of entry by cart, &c., to such bunkers, whence it is now usual to weigh it automatically to the stokers.

The removal of ashes may also be automatic if there is sufficient cellarage. Thus at the Shepherd's Bush station of the Kensington and Knightsbridge Co., Mr. Miller has arranged a Graham & Morton conveyor underneath the line of boiler furnaces. There are chain grate stokers which deliver clinker and ash behind the bridge wall or dumping plate into a deep hopper pit, which terminates in a cast-iron rectangular trunk or spout about 9 in. square, closed by a partly balanced valve. When sufficient clinker has accumulated, the valve door opens, and the clinker falls upon the conveyor, and the valve then automatically closes.

Hand-fired Lancashire or other boilers could be similarly arranged as regards a conveyor below, if the hearth-pit bottom was carried down for the purpose.

Specially to be avoided is the agitation of coal in such a manner as to cause it to fall through the air any distance at all, whereby the air becomes dust-laden by the winnowing action which takes places.

In arranging boilers in long banks, unless it seems desirable to have one or more passage ways between, any number of Lancashire boilers may be placed as close together as necessary.

It is not desirable to place water-tube boilers other than in pairs, with a passage way between each pair. The space is necessary for the purpose of vision through the sight holes to the furnace, and for introducing the steam brush for tube cleaning. This extra floor space must be duly considered when weighing up the floor space required by different types of boiler.

The position of the economiser is to be fixed upon. It or they may be placed parallel with the boilers and in the space that would be occupied by an additional boiler. The by-pass flue may run either at one side of or below the economiser, as space demands.

In Lancashire practice the main flue often runs across the end of the boilers, and the economiser is placed behind and parallel with it, the chimney being in line with the main flue; or there are two economisers on either side of the chimney, which stands in the centre of the main flue, or just behind it. Subject to other circumstances, of course, the flues ought to be as short and direct as possible.

Where Lancashire boilers are employed with superheaters behind, these must be so arranged that they can be cut out of the path of the hot gases and fully opened for inspection.

Special care ought to be exercised in so arranging a superheater in the back down-take of Lancashire or similar boilers that the hot gases really do travel between the pipes, and are not left to find their way more or less fortuitously between them.

With ordinary smoke-producing boiler settings the efficiency of a superheater will be much impaired, but when good settings are adopted and combustion is perfect the superheater will become too hot at times, and it may be advantageous to provide dampers to compel a part only of the gases to pass through the superheater, the remainder going direct to the flues.

When less steam is passed though the heater and mixed with saturated steam this system of regulation does not relieve the superheater of its excessive temperature exposure. The separate damper enables this to be done.

## PARALLEL OPERATION OF ALTERNATORS.

In the *Journal of the Franklin Institute* for April, 1902, is an article on the parallel operation of alternators, by Mr. Paul M. Lincoln, in which the difficulties of synchronising and parallel running are very clearly dealt with.

The successful operation of alternators in parallel consists in a proper division of the load and in freedom from hunting.

The proper division of the load is attained by having each prime mover controlled by a governor, which lowers the speed as the load increases, so that the maximum loaded prime mover tends to assume all decrements of load, while the minimum loaded one tends to assume all increments. While proportional division of load is desirable, it is not an absolute essential to successful operation. Freedom from hunting, on the other hand, is an essential, and where hunting exists to any pronounced extent successful parallel operation is impossible.

Hunting in synchronous machines is the oscillation of the armature masses, accelerated and retarded above and below average speed. Hunting of parallel connected alternators, like the swinging of a pendulum, dies out if not kept alive by some synchronous force, and may be kept alive, and even made violent, by an exceedingly small synchronous force,

provided movements can take place without undue friction. To prevent hunting it is therefore necessary to remove the synchronous forces which tend to keep alive the oscillatory motion and to provide electric friction tending to destroy such motion if once started.

One of the most potent factors in keeping alive hunting is the steam engine governor. The slight acceleration and retardation that hunting causes in the speed of the prime mover is sufficient to throw the governor into action, particularly if the governor is of a type in which inertia plays a prominent part. The delay in time between speed change and the corrective force applied by the governor is enough to cause a part, at least, of this corrective force to alternate synchronously with the speed changes. Thus hunting tends to induce in certain governors a synchronous force to keep itself alive. This can be remedied by prolonging the time of response to motion of the governor balls, which can be effected by the aid of properly-designed dash-pots.

Another cause of hunting is the uneven torque at different points of an engine-cycle if the natural period of oscillation is synchronous with the engine impulses. This cause can be remedied by synchronising the engines as well as the alternators, so that at any instant each engine is in a similar part of its cycle, or by additional fly-wheel capacity.

A further preventative for hunting is found by designing alternators, so that on the occurrence of hunting a resisting force of a frictional nature is set up. This can be done by surrounding the field poles, especially near the tips, with a band of copper, or by placing a copper plate which projects under the pole-tips. The eddy currents set up in the copper produce a damping effect whenever hunting occurs, and tend to stop it.

Not the least important part of paralleling alternators is the actual process of paralleling itself. For this purpose a synchroniser is necessary. The chief defect of most synchronisers is their inability to show whether the incoming machine is running too slowly or too quickly, and this seems to be overcome in a synchroniser designed by Mr. Lincoln. Mr. Lincoln's synchroniser operates a hand which revolves round a dial. When in operation the angle between the hand and its image printed on the dial is always equal to the phase angle between the E.M.F. of the bus-bars and that of the incoming alternator. If the alternator is running too fast the hand rotates clockwise, if too slowly counter-clockwise. The following description of the apparatus is taken from a paper read by Mr. Lincoln before the American Institute of Electrical Engineers, August 21st, 1901.

"Suppose a stationary coil F has suspended within it a coil A, free to move about an axis in the planes of both coils and including a diameter of each. If an alternating current be passed through both coils, A will take up a position with its plane parallel to F. If, now, the currents in A and F be reversed with respect to each other, coil A will take up a position 180° from its former position. Reversal of the relative directions of currents in A and F is equivalent to changing their phase relations by 180°, and, therefore, this change of 180° in phase relations is followed by a corresponding change of 180° in their mechanical relations. Suppose, now, that instead of reversing the relative directions of currents in A and F, the change in phase relations between them be made gradually, and without disturbing the current strength in either coil. It is evident that when the phase difference between A and F reaches 90°, the force between A and F will become reduced to zero, and a movable system, of which A may be made a part, is in condition to take up any position demanded by any other force. Let a second member of this movable system consist of a coil B, which may be fastened rigidly to coil A, with its plane 90° from that of coil A, and the axis of A passing through a diameter of B. Further, suppose a current to circulate through B, whose difference in phase relative to that in A is always 90°. It is evident under these conditions that when the difference in phase between A and F is 90°, the movable system will take up a position such that B is parallel to F, because the force between A and F is zero, and the force between B and F is a maximum; similarly, when the difference in phase between B and F is 90°, A will be parallel to F. That is, beginning with a phase difference between A and F of 0, a phase change of 90° will be followed by a mechanical change in the movable system of 90°, and each successive change of 90° in phase will be followed by a corresponding mechanical change of 90°. To investigate the mechanical relations corresponding to intermediate phase relations, suppose the phase difference between A and F to be 0. The force between A and F will then be a maximum, and that between B and F, 0. Now suppose a small change in phase between A and F to take place. The force between A and F becomes slightly less than the maximum, and that between B and F becomes other than 0. The movable system will take up the position of equilibrium between the forces on A and B, which will be somewhere intermediate between A parallel to F, and B parallel to F. It is further evident that the direction of motion of the movable system depends upon the sign of the differential change, so that such a device is not only responsive to a change of phase between A and F, but is also responsive to the direction of that change.

"It may be interesting to note that quadrature between A and B is not absolutely necessary, either in the mechanical angle between A and B or in the phase angle between their currents. So long as there is a displacement between A and B, both mechanical and electrical, the device is responsive to phase changes between A and F.

"The above is a brief description of the principles upon which rests this new synchronism indicator. Connect coil F to a set of bus-bars, and coils A and B to a dynamo that is to be parallel to those bus-bars, and in the motion of movable coils there is a constant index of the phase condition of the dynamo with respect to the bus-bars.

"In the commercial construction of the device, a laminated iron magnetic circuit is used, and the phase difference between A and B is secured by using a non-inductive resistance in series with one coil, and an inductance in series with the other. It is, of course, impossible to secure 90° phase difference in this manner, but sufficient difference can be obtained to answer all practical purposes. Current is introduced into the armature through three slip rings, one of the rings being made to do duty for one end of both armature windings.

"A synchroniser should perform three functions:—

"1. It should tell the amount of difference in frequency.

"2. It should tell whether the machine being synchronised is running too fast or too slowly.

"3. It should tell the exact point of synchronism.

"Comparing the above-described device with devices now ordinarily in use for the purpose of synchronising, we find:—

"1. In regard to the first point there is no difference.

"2. In regard to the second point the new device gives complete information, while ordinary devices give none.

"3. In regard to the third and most vital point, usual devices give only partial information, while that given by the new device is complete, not only at the point of synchronism, but at every other point in the cycle."

The device described above has been used to parallel the alternators of the Niagara Falls Power Co. with complete success. The five 5,000-H.P. alternators can, by its aid, be thrown into parallel in 3 minutes, as against 15 to 20 minutes required for the same operation if any other known form of synchroniser is used.

## SOUTH AFRICAN NOTES.

[From Our Special Correspondent at Johannesburg.]

*Sea-Point and Green-Point, Capetown.*—The above municipality has given notice of its intention to apply for leave during the next ensuing session of Parliament to introduce a Bill into the House of Assembly, which, amongst other clauses, contains the following:—"8. To authorise the Council to establish a system of electric lighting within the municipality, to frame tariffs of charges in connection with the supply of light and power, and for framing necessary regulations with regard thereto."

*Bulawayo, Rhodesia.*—The editor of the *Bulawayo Chronicle*, in commenting upon the latest report of the Chartered Co., remarks that "his (Mr. Jones, of the Chartered Co.) whole attention is absorbed by the mining industries, and he does not perceive that what is now required is a number of light railways and tramways piercing the agricultural districts." Whilst praising the success of the company in extending the railways (they have now laid trunk and branch lines to Selukwe, Mazoe, Lomagunda and Gwanda), he

remarks:—"It is of infinitely more importance that these should be taken in hand than that the railway should reach Khartoum." Here is a splendid opportunity for the promoters of the great Victoria Falls scheme (if there is one). It has recently been asserted that there could be enough power developed from the Falls to drive all the railways in Africa, the Falls being twice as high as Niagara, and developing five times the power in the rainy season.

*Durban, Natal.*—After long delay, the Council has decided to reduce the tram fares. In future the fare will be 2d. per stage, and to benefit the regular users, books of 100 tickets will be issued at a reduction of 25 per cent., *i.e.*, equivalent to 1½d. per stage. Also *bonâ fide* school children will be carried, to and from school, free.

*Transvaal Telegraphs.*—Telegraphic communication has now been established in the following places:—Amersfoort, Balmoral, Benoni, Biesjesvlei, Cleveland, Eureka, Florida, Knights, Lake Chrisie, Luipaardsvlei, Nigel, Piggspeak, Pilgrim's Rest, Roodepoort, Vanwyksrust and Venterskroom.

*Pretoria Lighting Co.*—At the annual meeting of this Company, the accounts presented showed a profit for last year of £10,626, the total revenue being £8,000 in excess of the previous year. The company had made arrangements for a great increase in its power and light supply, while promising a reduction of prices.

*Johannesburg.*—The Chamber of Trade continues to criticise the Council's electric light, power and tramway scheme. Owing to the Chamber's action it seems highly probable that a Government inquiry will be held before the money is expended. A few words about this chamber will not, under the circumstances, be out of place. The majority of the members formerly belonged to the Chamber of Commerce here, but owing to differences of opinion, and interests not being identical, a number of them last year seceded and formed themselves into the present Chamber of Trade. It is mostly composed of engineers interested in the mining industry, amongst them being the following:—

Mr. W. Leslie Daniels (president), head of a large firm of engineers.

Mr. W. J. Green (vice-president), representative of H. Mosenthal and Co., head of a large firm of engineers.

Mr. Otto Lenz, of Reunert & Lenz, one of the largest firms of electrical engineers on the Rand, representative of Mather and Platt, Parsons steam turbines, &c.

Mr. W. E. Park, manager, Fraser & Chalmers, the largest firm of mining engineers on the Rand, controlling quite one half of the whole trade, representative of Dick, Kerr & Co., &c.

Mr. A. F. Robinson, of A. Koppel, Ltd., engineers.

Mr. H. D. Soloman, manager, British Engineers' Alliance, &c.

The only dissentient is Mr. J. W. Kirkland, manager of the S.A. General Electric Co. (of New York).

## NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

7,314. "Improvements in and relating to overhead wiring for electric power transmission, railways, tramways and the like." T. W. Wilson. March 30th.

7,335. "Improvements in electric collector shoes or slippers for the insulated third rail of electric railways and tramways." E. J. Chambers. March 30th.

7,337. "Improvements in terminals for secondary or electrical storage batteries." E. A. Tunbridge. March 30th.

7,348. "Improvements in or relating to electrical induction apparatus." A. Loebl and American Electrical Novelty and Manufacturing Co., Ltd. March 30th.

7,359. "Improvements in electric meters." E. A. Carolan. (The General Electric Co., United States.) March 30th.

7,367. "Improvements in maximum ampere indicators or registers for electric circuits." H. McGilliveay, G. Carr and J. H. Douglas. March 30th.

7,374. "Application of electric influence at a distance." W. Hepworth. March 30th.

7,376. "Improvements in electric switches." C. H. Davies. March 30th.

7,384. "Improvements relating to electric machines." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) March 30th. (Complete.)

7,385. "Improvements in and relating to electricity meters provided with means for registering the maximum consumption." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) March 30th. (Complete.)

7,387. "Improvements in, or relating to, the standards and supporting devices of the trolley or current-collecting poles of electric vehicles." W. H. Turner and W. H. Isherwood. March 30th.

7,409. "An improved apparatus for commuting electric currents, particularly applicable to combined arc and incandescent lighting circuits." C. Smart. March 31st.

7,415. "A new or improved two-way electrical switch." E. W. Lewis. March 31st.

7,427. "Improvements in cases or covers for electrical switches or fuses." C. M. Dorman and R. A. Smith. March 31st.

7,449. "Improvements in electrically-operating shutters, sliding doors and the like." K. Reul. March 31st.

7,453. "Improvements in high tension electric circuit breakers." E. A. Carolan. (The General Electric Co., United States.) March 31st.

7,458. "Improvements in electric meters." E. A. Carolan. (The General Electric Co., United States.) March 31st.

7,455. "Improvements in connection boxes for electric conductors." E. A. Carolan. (The General Electric Co., United States.) March 31st.

7,456. "Improvements in supports and casings for electric contactors." E. A. Carolan. (The General Electric Co., United States.) March 31st.

7,458. "Improvements in couplings for electric cables." E. A. Carolan. (The General Electric Co., United States.) March 31st.

7,459. "Improvements in electric arc lamps." E. A. Carolan. (The General Electric Co., United States.) March 31st.

7,460. "Improvements in electric meters." E. A. Carolan. (The General Electric Co., United States.) March 31st.

7,461. "Improvements in electric circuit protecting devices." E. A. Carolan. (The General Electric Co., United States.) March 31st.

7,462. "Improvements in electric motor-control systems." E. A. Carolan. (The General Electric Co., United States.) March 31st.

7,474. "Improvements in or relating to induction motors." W. G. Colles and A. Meuschel. March 31st.

7,481. "Improvements in controllers for electric motors." H. R. Stuart. (Date applied for under Patents Act, 1902, April 2nd, 1902, being date of application in United States.) March 31st. (Complete.)

7,516. "Improvements in and connected with electro-magnetic brake dynamometers." V. A. Fynn. March 31st.

7,527. "An improvement in ceiling roses, cut-outs, and the like for electric lighting purposes." R. T. Grocott. April 1st.

7,530. "Improvements in or connected with means for electrically-igniting miners' safety lamps." B. D. Williams. April 1st. (Complete.)

7,543. "The 'electric attachment or guide' for use on the 'Rem-sho typewriter and other machines similarly constructed." E. Lowther. April 1st.

7,561. "Improvements in electric-current controllers." L. Bradley and S. Allen. April 1st. (Complete.)

7,568. "Improvements in fusible electric cut-outs." J. Hetherington and the British Electric Transformer Co. (1903), Ltd. April 1st.

7,585. "Improvements in apparatus for enabling telephonic and telegraphic message to be transmitted over the same line." C. Turchi and E. Brune. April 1st. (Complete.)

7,587. "Improvements in electrolytic meters." E. A. Carolan. (The General Electric Co., United States.) April 1st.

7,590. "Improvements in electro-magnetic mechanism for producing reciprocatory motion." J. T. Mould. April 1st.

7,607. "Improvements in inter-communication telephone apparatus." V. A. Ryan. April 1st.

7,608. "Improvements in continuous-current arc lamps." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) April 1st. (Complete.)

7,618. "Improvements in and relating to switches for starting and regulating electric motors." J. T. Mould. April 1st.

7,625. "Improvements in and relating to trolleys for electric tramcars." J. Aldworth. April 2nd.

7,639. "Improvements in standards and trolley boom controlling apparatus for electric tramcars and the like vehicles." S. Hindley. April 2nd.

7,697. "Improvements in electric lamps." R. Drecker. April 2nd. (Complete.)

7,700. "Improvements in electric fire alarms." J. W. H. Uytenbogaart. April 2nd. (Complete.)

7,701. "Improvements in electric receiver clocks." J. W. H. Uytenbogaart. April 2nd. (Complete.)

7,713. "Improvements relating to electric switching arrangements." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) April 2nd. (Complete.)

7,714. "Improvements relating to monophase and polyphase alternating current machines." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) April 2nd. (Complete.)

7,716. "Improvements in means for controlling the working of periodically operating electric machinery." J. Y. Johnson. (The Elektrizitäts Aktien-Gesellschaft vormals W. Lahmeyer & Co., Germany.) April 2nd.

7,719. "Improvements in the creation and multiplication of electricity applicable to any kind of machinery requiring force." T. J. Howell. April 2nd.

7,742. "Improvements in electric hair brushes." J. S. Collins. April 3rd.

7,773. "Improvements in and relating to secondary batteries." E. C. Ekstromer and G. H. Lloyd. April 3rd.

7,783. "Improvements in carbon electrodes for arc lamps." A. Edelmann. April 3rd.

7,789. "Improvements in telephone systems." T. Paul and J. L. McDougall. April 3rd. (Complete.)

7,790. "Improvements in safety electric fuses." G. W. Partridge. April 3rd.

7,808. "Improvements in and relating to fittings for trolley wires of electric traction systems." N. Clough. April 3rd.

7,827. "Improvements in electric switch apparatus." H. Pieper. April 4th.

7,831. "Improved process of manufacturing electrodes of arc lamps." R. Hoffert. April 4th. (Complete.)

7,839. "Improved means for connecting together the sections of drain cleaning tools, chimney cleaning brushes, pulling through rods for electrical conduits, and for certain other purposes." G. Davis, W. Davis and S. Davis trading together as Marshall Brothers). April 4th.

7,842. "Electric arc lamp." A. Bureau. April 4th.

## PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

3,967. "Improvements connected with electrically connecting tram and like rails." G. H. Archer. Dated February 17th.

4,274. "Improvements in or relating to electric cells or batteries." H. H. Lake. (Société Anonyme "Le Carbone," France.) Dated February 19th.

4,285. "Improvements in sockets for incandescent electric lamps." A. E. Ellen. (The Yost Miller Co., U.S.A.) Dated February 19th.

4,645. "Improvements in the manufacture of rail-bonds for electric railways." G. G. M. Hardingham. (Communicated.) Dated February 24th.

5,425. "Improvements in trolley heads for electric traction." J. H. Walker. Dated March 4th.

5,891. "Improvements in electrical measuring instruments." V. A. Arcioni. Dated March 10th.

6,009. "Improved fire alarm telegraph repeater apparatus." L. G. Woolley. Dated March 11th.

9,502. "Improvements in and relating to electrical fuse boxes." E. F. Moy, P. H. Bastie and E. F. Moy, Ltd. Dated April 26th.

9,947. "Improvements in an electric low-water alarm for steam boilers." C. A. Allison. (A. Graham, U.S.A.) Dated April 30th.

9,966. "Improvements relating to telephone receivers and the like." H. H. Lake. (Akouphone Manufacturing Co., U.S.A.) Dated April 30th.

10,541. "Improvements in and relating to electric clocks and indicating dial mechanism for use in connection therewith." W. E. Palmer. Dated May 7th.

11,851. "Improvements relating to the windings of electric transformers and other high potential windings." H. H. Lake. (General Electric Co., U.S.A.) Dated May 24th.

13,749. "Improvements in electro-chemical generators." C. H. Graham, G. D. Bouton and H. S. Annwake. Dated June 17th.

14,188. "Improvements relating to apparatus for controlling electric motors." H. H. Lake. (General Electric Co., U.S.A.) Dated June 21st.